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PREFACE

It is a distinct pleasure to complete volume 7 of the bibliography, the principal publication of the Polar Continental Shelf Project. This publication continues to be a useful medium for those interested in the scientific activities of many individuals and agencies in the Canadian Arctic. We continue to hope that our efforts to produce this volume are of continued value; from the feedback we get it would appear that use is indeed made of this publication which then makes our efforts worthwhile.

To repeat what has been stated earlier, you will note that the material in this bibliography has been set out by scientific discipline with an author index. We trust that over the years we have managed to get your contribution under the discipline to which it rightfully belongs. We trust also that we have not made too many mistakes. We would be very happy to listen to any suggestions that you might have, be it in the immediately above matter or anything that might improve the quality and value of this publication.

We have already started to accumulate items for volume 8 and we would appreciate being made aware of publications as they come from your pen and attain the light of day. Our support to your project is surely worth a copy of any paper that arises from that support. We thank you for all your support in the past and for your encouragement.

April 1, 1987

La publication principale de l'Etude du Plateau Continental Polaire est sa bibliographie. Il me fait un plaisir d'achever son volume numéro 7.

Cette publication continue d'être une voie utile pour les intéressés des activités scientifiques dans l'Arctique canadien. Nous espérons toujours que la production de ce volume est de valeur continuelle et d'après l'informations qui nous est revenues, il est évident qu'on utilise ces publications, qui fait que nos efforts sont bien mérités.

Pour réitérer ce qui a déja été déclaré, veuillez noter que les matières dans cette bibliographie ont été établies par disciplines scientifiques avec une liste d'auteurs. Nous espérons que dans les années précédentes nous avons reçus vos contributions sous la discipline de bonne appartenance, et à moindre d'erreurs. Nous invitons vos suggestions dans les matières sus-mentionnées qui augmenterons la valeur et qualité de cette publication.

Nous avons déja commencé à amasser les items pour le volume numéro 8, et nous apprécierions d'être mis au courant de toutes autres publications écritent par vous qui ont atteint la lumière du jour. Nous vous demandons de nous faire parvenir une copie de toutes publications qui soulèvent des projets dont vous avez obtenu divers soutiens logistiques de notre organisation. Nous vous remercions de toute appui et encouragement reçus dans le passé.

le 1 avril, 1987

CONTENTS

	Page
Preface	iii
Archaeology	1
Bathymetry	3
Biology	3
Botany	18
CESAR	22
Climatology	30
General	34
Geology	35
Geophysics	73
Glaciology	78
History	81
Hydrography	82
Hydrology	82
Ice Island	86
LOREX	87
Oceanography	88
Author Index	92

ARCHAEOLOGY

2539 ARNOLD, C.D. - 1982
The Intellectual Context; *Northern Perspectives*, vol. 10, no. 6, November-December 1982, pp. 1-4.

SOMETIME around 12,000 years ago, the changes in terrestrial climate that brought the Pleistocene Ice Age to an end set in motion events that were to alter the configurations of cultures over broad areas of the earth. In the Northwest Territories, the melting of glacial ice and subsequent evolution of the landscape were major factors influencing human occupation and cultural adaptations. These adaptations included not only technological innovations, but also the development of social institutions, and together these permitted man to come to terms with some of the most rigorous environmental conditions to be found anywhere in the habitable world. The application of scientific techniques of archaeology, combined with judicious borrowing from other fields of study, has resulted in a corpus of information on the events of the prehistoric period. In turn, the Northwest Territories provides a proving ground for the development and testing of new archaeological procedures and in this way contributes to the discipline as a whole.

2540 ARNOLD, C.D., and STIMMELL, C. - 1983
An Analysis of Thule Pottery; *Can. J. Archaeology*, vol. 7, no. 1, pp. 1-21.

Archaeological reconnaissance of the southeastern coast of Banks Island, N.W.T., has revealed the presence of several seasonal camps of the Thule culture near the mouth of the Nelson River. Excavations have demonstrated that these are to be added to a growing roster of Thule sites in the western Canadian Arctic that represent a different aspect of Thule than do the majority of those in the central and eastern regions. One difference lies in the abundance of pottery in western Canadian Thule sites, yet to date there have been only casual assessments of the significance of this trait.

In fact, the following analysis of pottery from one of the Nelson River sites shows that these attributes are an efficient compromise to the various problems encountered when making and using pottery in the Arctic.

2541 ARNOLD, C.D. - 1983
A Summary of the Prehistory of the Western Canadian Arctic; *the musk-ox*, no. 33, pp. 10-20.

The western regions of the Canadian Arctic bear evidence of human occupation extending more than 3500 years into the past. Although the western Canadian Arctic cannot be separated from adjacent regions when constructing cultural histories, prehistoric occupations of that area often show significant differences when compared to their neighbours to the east and the west. Viewed on a regional basis, the archaeological record provides a glimpse into the complexity of cultural development in the Arctic.

2542 BEATTIE, O.B. - 1983
A Report on Newly Discovered Human Skeletal Remains from the Last Sir John Franklin Expedition; *the musk-ox*, vol. 33, pp. 68-77.

Human skeletal remains representing seven to fifteen individuals from the last Sir John Franklin Expedition have been recovered from two widely separated areas on King William Island, N.W.T., during archaeological surveys conducted in 1981 and 1982. Osteological analysis of the material demonstrates the probable presence of scurvy, as well as features suggestive of cannibalism. The distribution of the skeletal materials from one site in Erebus Bay (the 'boat place') supports the interpretation made by M'Clintock in 1859 that a boat left at this site, probably during the summer of 1848, indicates that its crew was heading back to the two abandoned and ice-bound ships located 90 km north-northeast.

2543 BIELAWSKI, E. - 1982
Spatial Behaviour of Prehistoric Arctic Hunters: Analysis of the Site Distribution on Aston Bay, Somerset Island, N.W.T.; *Can. J. Archaeology*, no. 6, pp. 33-45.

Cultural and spatial analyses of prehistoric sites on Aston Bay suggest that behaviour was spatially patterned, and that the pattern changed through time. Early Arctic Small Tool tradition people were exploring adaptational possibilities, wintering on the coast and travelling inland during the summer. Dorset people, in contrast, used the coast as a stop on their journeys between the sea ice and the interior. Thule people found the area relatively unsuitable for occupation. The relevance of the study for method and theory is discussed.

2544 BIELAWSKI, E. - 1983
Northern Archaeology to 1983: a Perspective from Arctic Prehistory; *the musk-ox*, vol. 33, pp. 37-41.

Two views of current arctic archaeology illustrate that divergent approaches continue to affect the course of northern research. Description of a process of action and reaction in Arctic archaeological research provides the historical context for some of the academic disciplinary, and social context problems faced by northern archaeology in 1983.

2545 BIELAWSKI, E. - 1985
Northwest Territories Archaeology Field Work in 1984; *Prince of Wales Northern Heritage Centre*, Archaeology Report no. 1, 15 p.

In this report, archaeologists write about their finds for the people of the Northwest Territories.

In the summer of 1984, archaeologists once again worked far and wide across the forests and tundra. From Truelove Inlet in the northeast to Tsu Lake in the southwest, archaeologists recorded and collected stories and artifacts of northern heritage. Whether looking for small stone tools over 3500 years old in the central Arctic, living in a Dene camp to learn how people made and used tools, or mapping and digging Thule Inuit houses which had been damaged by bulldozers, archaeologists brought back new knowledge about our past.

2546 HETT, C.E.S. - 1983
The Role of Conservation in Northern Archaeology; *the musk-ox*, no. 33, pp. 78-82.

Northern archaeology holds great interest for the conservator due to the high degree of preservation in northern burial environments. Several case histories which illustrate the value of close collaboration between archaeologists and conservators are summarized here. It is recommended that archaeologists accept responsibility for ensuring a high standard of preservation for sites and artifacts. In turn, conservators must accept various constraints inherent in northern fieldwork.

2547 HUNTER, J.A., KORNIK, L.J., MacAULAY, H.A., and BIGHAM, J. - 1982
The Haycock Expedition in search of 'Victory' artifacts, Victoria Harbour, Boothia Peninsula, Northwest Territories geophysical surveys; *Polar Cont. Shelf Proj.*, internal report, 39 p.

The specific objectives of this particular site were: 1) to delineate the wreck of the "Victory" presumed to be lying on the seabottom of Victoria Harbour; 2) to locate, by geophysical means, a buried cache of instruments left on land by Sir John Ross in 1832.

To apply geophysical techniques to these archaeological targets, instruments and techniques were developed which would be applicable in ice-covered waters and to small targets on land in a permafrost setting.

2548 JANES, R.R. - 1982
The Social Context; *Northern Perspectives*, vol. 10, no. 6, November-December 1982, pp. 5-10.

ARCHAEOLOGY, particularly northern archaeology, cannot be separated from the social context within which it is practised. This paper outlines the northern social context and examines its implications for archaeologists, as well as for the general population of the Northwest Territories.

2549 JANES, R.R. - 1983
Public Archaeology in the Northwest Territories; *the musk-ox*, no. 33, pp. 42-48.

With the establishment of an Archaeology Program in 1982, the Prince of Wales Northern Heritage Centre began to assume greater responsibilities for the protection of the archaeological resources of the Northwest Territories. This paper reviews areas of responsibility, summarizes problems encountered in doing archaeology in the Northwest Territories, and advocates particular approaches to cultural resource management. Those approaches which are favoured combine education, public participation, and dissemination of information with sound research goals.

2550 MARY-ROUSSELIÈRE, G. - 1984
Une remarquable industrie dorsetienne de l'os de caribou dans le nord de Baffin; *Polar Cont. Shelf Proj.*, internal report, 18 p.

Les sites de Nunguvik et de Saatut, dans le nord de la Terre de Baffin, ont révélé une importante industrie dorsetienne de l'os de caribou qui jusqu'à présent est sans équivalent ailleurs dans l'Arctique canadien. Cette industrie était spécialisée dans certains outils caractéristiques fabriqués surtout au camp de chasse au caribou de Nunguvik mais utilisés pour la plupart au camp de chasse au phoque et de pêche de Saatut.

2551 McGHEE, R. - 1983
Eastern Arctic Prehistory: the Reality of a Myth?; *the musk-ox*, no. 33, pp. 21-25.

On the basis of over 50 years of archaeological work in the eastern Arctic, most archaeologists currently working in the area share a common set of concepts regarding the major outlines of eastern Arctic prehistory. It is postulated that these shared concepts, and the way in which they are used, bear certain resemblances to mythology as well as to objective thought. Examples are presented to suggest that the study of eastern Arctic prehistory shares certain patterns with mythological belief: acceptance of prior authority, intolerance of alternative views, and a search for simple explanations for complex phenomena.

2552 McGHEE, R. - 1984
Fieldwork Report: 1984; *Nat. Museum Man*, internal report, 21 p.

Fieldwork was carried out by myself and Jean-Claude Moquin (University of Montreal) under two permits (numbers 563 and 564) issued by the Government of the N.W.T., and involved four separate areas which are reported individually below. The artifacts, catalogues, site forms and fieldnotes are currently housed at the Archaeological Survey of Canada.

2553 McGHEE, R. - 1984
Contact between native North Americans and the medieval Norse: a review of the evidence; *American Antiquity*, vol. 49, no. 1, pp. 4-26.

Historical and archaeological evidence relating to Norse activities in the New World early in the second millennium A.D. is reviewed, together with archaeological evidence relating to contemporaneous aboriginal occupations of the regions probably reached by the Norse. The Norse probably contacted Indian populations in southern Labrador and Newfoundland, Dorset Palaeoeskimos in northern Labrador, and Thule Eskimos in Greenland and perhaps in the eastern Canadian Arctic. Speculation on the nature of relationships between the Norse and these groups is presented, and it is concluded that occasional contacts involving both trade and plundering probably occurred over a period of several centuries. There is no evidence to indicate that these contacts had any major influence on aboriginal North American populations, and it is argued that such influences are unlikely to have occurred. The most important result of contact between these groups was the prevention of European colonization of the New World for half a millennium.

2554 McGHEE, R. - 1984
The Thule village at Brooman Point, High Arctic Canada; National Museum of Man Mercury Series, *Archaeological Surv. Can.*, Paper no. 125, ISSN 0317-2244, 158 p.

The Brooman Point site lies at the southern tip of a peninsula extending from the eastern coast of Bathurst Island, in the central High Arctic (75°23'30"N, 97°17'30"W). As well as components relating to Predorset, Early Dorset and Late Dorset occupations, the site includes the remains of 20 Thule winter houses and associated features. Ten of these houses were excavated in 1979 and 1980, and the description and interpretation of these remains forms the basis of the present report.

It is concluded that the Thule component at the site represents a series of brief occupations, during each of which approximately three to five winter houses were occupied by a small community composed of a core of related families who returned to the site each winter, and on an occasional basis by peripheral families The entire period of site occupation may have occurred within only one or two decades; radiocarbon dates and stylistic comparisons suggest that the occupation most probably dates to the early twelfth century A.D. Subsistence was based primarily on sea mammal hunting, which was concentrated at a local polynia during the season of site occupation; summer open-water hunting of sea mammals including bowhead whales was carried out at another locality.

The Brooman Point component may be grouped with others on Cornwallis, Devon and northern Baffin Island to form the "Resolute phase" of the early Thule period, representing a "tribal" social unit of the eleventh century A.D. Other such units are proposed in an attempt to more clearly understand the nature of the early Thule occupation of Arctic Canada.

2555 MORRISON, D.A. - 1984
The Late Prehistoric Period in the Mackenzie Valley; *Arctic*, vol. 37, no. 3, pp. 195-209.

Artifacts from more than 20 late prehistoric components in the Mackenzie Valley are described and compared with those from contemporaneous assemblages from neighbouring areas. MacNeish's Spence River phase is expanded to cover this material, which seems to exhibit at least some integrity and distinctiveness, and which appears to date from about A.D. 700 to the time of European contact. Certain technological similarities are noted with the Klo-Kut and Aishihik phases to the West and the late Taltheilei tradition to the East, but these similarities are difficult to synthesize into any meaningful outline of Canadian Athapaskan prehistory.

BATHYMETRY

2556 de HEERING, P., SUTCLIFFE, P., and DesPAROIS, M. - 1984
Underwater measurements of impact noises on ice; Presented at Can. Acoustical Assoc. Sym. of Can. Astronautics Ltd., October 22-26, 1984, Quebec City, P.Q. 6 p.

As part of a contract with the Canadian Hydrographic Service, Department of Fisheries and Oceans, the authors measured, by means of underwater hydrophones the noise impulses produced in the water under an ice layer when a bullet shot from above the ice, hits it. These measurements had the purpose of developing an impulsive sound source, that is sufficiently cheap and easy to implement to serve for a variety of purposes, and, in particular, that of performing acoustic soundings of the water underlaying the Arctic ice.

2557 de HEERING, P., SUTCLIFFE, P., and DesPAROIS, M. - 1985
Non-contact through-the-ice sounding of Arctic waters; *in* Proc. Dixième Colloque sur le traitement du signal et ses applications, May 20-24, 1985, Nice, France.

Under a contract with the Canadian Hydrographic Service (Department of Fisheries and Oceans), the authors are developing a through-the-ice sounding system that is capable of being operated from a helicopter in flight.

Basically, the system performs acoustic sounding, with the excitation and receiving functions being separated and somewhat unconventional.

2558 MacDOUGALL, J.R. - 1984
Final Field Report, P.C.S.P. survey, Prince Regent Inlet, Proj. File no. 5452-7312; *Fisheries and Oceans*, Can. Hydrographic Serv., Central Region, internal report, 99 p.

This report covers the 1984 Polar Continental Shelf Project Survey of Prince Regent Inlet. Five Bell 206 helicopters flew a total of 1497.1 hours between March 6 and April 24 supporting bathymetric and gravity operations. A total of 9627 shot soundings were collected on a 2 kilometre grid, and 1021 gravity observations obtained on a 6 kilometre grid, with the hydrographers assigned to the party collecting both soundings and gravity data. An additional 40 soundings and gravity observations were collected in Peel Sound to delineate a suspected gravity anomaly.

BIOLOGY

2559 ALLAN, R.B., and MACKENZIE-GRIEVE, G.R. - 1983
Water quality and biological survey of Stokes Point and King Point, Yukon - Beaufort Sea Coast; *Env. Can.* Env. Protection Serv. Pacific Region, Yukon Branch, Regional Program Report no. 83-23, 70 p.

A baseline inventory of water chemistry, sediment and biological conditions was undertaken by the Environmental Protection Service on the Beaufort Sea coast of the Yukon in August 1982. Investigations were conducted in two areas of potential development at King Point and Stokes Point with samples being collected from lake, lagoon and nearshore marine habitats.

The nearshore marine stations were predominated by the Arctic water mass with localized mixing occurring. Sediment metal levels and oils and grease levels were found to be typical of other Beaufort Sea sediments. Twenty three species of benthic invertebrates were identified. Four species not previously recognized in other Beaufort Sea literature were identified in the Stokes Point nearshore marine samples.

The lagoons have brackish water characteristics reflecting recent closure and separation from marine water. King Point lagoon exhibits lower salinity and conductivity than Stokes Point lagoon. One station at Stokes Point Lagoon showed excessively high oils and grease levels.

Water chemistry data from the freshwater lake sample indicated low nitrite, nitrate levels.

Tissue samples were obtained from two fish species and one isopod species and analyzed for extractable metals.

2560 ALLAN, R.B., and MACKENZIE-GRIEVE, G.R. - 1984
Water quality and biological survey of five streams in the vicinity of Stokes Point, Yukon - Beaufort Sea Coast; *Env. Can.*, Env. Protection Serv. Pacific Region, Yukon Branch, Regional Program Rep. no. 84-19, 56 p.

A baseline inventory of water chemistry, sediment, and biological conditions on five streams by the Environmental Protection Service. The streams investigated include Deep Creek, Babbage, Trail, Crow, and Spring Rivers. Sampling was conducted in August 1982 and August 1983.

The streams surveyed have been previously categorized as being either a mountain or tundra stream based on the origin of the headwaters region. The water chemistry of mountain streams was typically higher in pH, conductivity, filterable residue, alkalinity and hardness. This difference was further supported by higher concentrations of extractable calcium and magnesium in both the water and sediment samples from mountain streams.

Thirty-five species of benthic invertebrates were identified. Dipterans were the most dominant group both in terms of number of species and number of individuals collected. A new species of amphipod, *Synurella* sp., was collected. Bottom fauna data indicated that higher densities were associated with clean, gravel substrates and sampling did not show any noticeable differences between the mountain and tundra stream types.

2561 BADA, J.L., MITCHELL, E., and KEMPER, B. - 1983
Aspartic acid racemization in narwhal teeth; *Nature*, vol. 303, no. 2, pp. 418-420.

We report here that the extent of aspartic acid racemization in narwhal teeth provides a means for determining the age of narwhals. This method may be particularly useful for mature females, the ages of which have previously been difficult or impossible to determine.

2562 BARSCH, D., and KING, L. - 1981
Faunal notes of the Heidelberg Ellesmere Island Expedition 1978, Oobloyah Bay, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 565-567.

Observations of birds and mammals were collected by several members of the expedition, as time and occasion permitted. The bird identifications should be regarded as tentative, as there were no ornithologists in the party.

2563 BOND, W.A., and ERICKSON, R.N. - 1985
Life History Studies of Anadromous Coregonid Fishes in Two Freshwater Lake Systems on the Tuktoyaktuk Peninsula, Northwest Territories; *Fish. and Oceans*, Can. Tech. Rep. Fish. Aquat. Sci. no. 1336, 68 p.

The Tuktoyaktuk Peninsula is dotted with large numbers of interconnected tundra lakes which drain into the southern Beaufort Sea through small streams. Many of these streams support runs of anadromous coregonid fishes that utilize the lakes as feeding, rearing, and overwintering areas. Two such streams, Mayogiak Creek and Freshwater Creek, flow directly into Tuktoyaktuk Harbour where greatly increased vessel traffic and shoreline development have occurred in recent years. The purpose of the present study was to document and describe fish migrations within these two streams and to determine the significance of the two lake systems as fish habitat, especially for anadromous coregonids.

A preliminary investigation in 1981 verified the occurrence of substantial migrations of broad whitefish, *Coregonus nasus* (Pallas), lake whitefish, *C. clupeaformis* (Mitchill), and least cisco, *C. sardinella* (Valenciennes) in both streams. Work in 1982 concentrated on the Freshwater system in which the larger runs appeared to occur. This report highlights the results of the second year's work and attempts to draw together the results of both years.

A two-way fish counting fence was operated on Freshwater Creek from break-up, 21 June, to freeze-up, 12 October 1982. Upstream migrants totalled 100 178 broad whitefish, 9 684 lake whitefish, and 10 599 least cisco. Downstream figures for the same species were 105 149, 22 382, and 5 229, respectively. At the fence site data were collected describing the diel and seasonal timing of the migrations, the length-frequency distribution of the migrant populations, age and growth, sex and maturity, and food habits.

Most migrants were juvenile fish although the runs included mature spawners of all three coregonid species. Downstream migrations of broad whitefish, which began in July, included mature spawners which had overwintered within the watershed. Some broad whitefish and least cisco enter the lakes as young-of-the-year and may re-

main in the lakes for up to four years before returning to coastal habitats. On the other hand the runs of lake whitefish included few fish younger than age 4.

Brief surveys were conducted on nine lakes in the two watersheds to gather information on lake morphometry, water chemistry, benthic invertebrates, and zooplankton, as well as fish. Overwintering coregonids were captured in two lakes of the Freshwater Creek system while only northern pike, *Esox lucius* Linnaeus, were taken through the ice in the Mayogiak watershed.

2564 BORSTAD, G.A., and GOWER, J.F.R. - 1984
Phytoplankton Chlorophyll Distribution in the Eastern Canadian Arctic; *Arctic*, vol. 37, no. 3, pp. 224-233.

The distribution of phytoplankton chlorophyll concentration in Jones Sound, Lancaster Sound, and Eastern Baffin Bay was studied during the period 16-27 August 1979, using continuous ship-based horizontal and vertical profiling and continuous aerial water colour measurements. These data are discussed in relation to physical data collected from the ship, and to infrared temperature measurements made from the aircraft and the TIROS series satellites.

While the satellite and airborne remote sensing techniques are capable only of viewing the near-surface layer, they provided a much more detailed and synoptic coverage of this large area than was possible using a vessel alone. Together the three types of data provide a reasonably detailed picture of phytoplankton distribution which compares well with other physical oceanographic data.

On average the chlorophyll standing crop was moderate (69 $mg.m^{-2}$ in the top 3.5 m.n = 24) and comparable to that reported for other open water arctic regions, but the phytoplankton were not evenly distributed vertically or geographically. In Jones Sound and Lancaster Sound where local ice melt reduced the surface water density, strong subsurface chlorophyll maxima (up to 18 $mg.m^{-3}$ in a 1 m thick layer) were observed in association with the pycnocline. At the mouths of these sounds and along the eastern coast of Devon, Bylot, and Baffin Islands the phytoplankton distribution was more vertically homogeneous and closely linked to the physical structure of the Baffin Current. Highest pigment concentrations were associated with eddies or meanders in the current. It is possible that these localized pigment concentrations are one manifestation of 'biological hotspots' which help feed the large populations of marine birds and mammals of the eastern Arctic.

2565 BORSTAD, G.A. - 1985
Water Colour and Temperature in the Southern Beaufort Sea: Remote Sensing in Support of Ecological Studies of the Bowhead Whale; *Fish. and Oceans*, Can. Tech. Rep. Fish. Aquat. Sci. no. 1350, 73 p.

Comparison of the geographic distribution of bowhead whales in the southern Beaufort Sea and coincident observations of water colour, chlorophyll a fluorescence and/or temperature made from aircraft and satellites during August-September 1980-1983, show that important congregations of bowheads (and many smaller groupings also) tend to occur in the vicinity of oceanographic phenomena manifesting themselves as surface temperature or turbidity fronts and anomalies. This is in agreement with suggestions that bowheads feed in areas of local zooplankton abundance, since zooplankton are known to often accumulate at discontinuties and upwellings. It may be possible to use satellite imagery to predict bowhead distribution.

2566 BRUEMMER, F. - 1984
How Polar Bears Break the Ice; *Natural History*, vol. 93, no. 12, pp. 38-47.

To get along at Cape Churchill, Canada, a bear must communicate clearly in a language of yawns, sniffs, and roars.

2567 CALVERT, W., and STIRLING, I. - 1983
Winter distribution of ringed seals in the Barrow Strait area, Northwest Territories, as determined by underwater vocalizations; *Can. Wildl. Serv. & Univ. Alberta* Rep. prepared for the Arctic Pilot Project, 17 p.

We made recordings from 23 to 30 April 1982 at 32 sites chosen to represent different habitats in the High Arctic, in order to assess under-ice distribution of ringed seals in winter. Winter habitat selection was investigated by regressing the vocalization rate at each site against variables for habitat quality. Sites in smooth inter-island channels had significantly more vocalizations while sites in bays had significantly less; sites which had frequent human activity had vocalization rates similar to the over-all average. Although there were some differences in vocalization rates which corresponded to measured and estimated habitat variables, there was too much overlap between sites for this technique to be useful in separating suitable and unsuitable pupping habitat. Recordings made at one site over 4 days showed a diel rhythm that was higher during the time when we recorded than at other times.

2568 CLEATOR, H., and SMITH, T.G. - 1984
Vocal behaviour and distribution of bearded seals, *Erignathus barbatus*, in Amundsen Gulf and along western Banks Island, Northwest Territories; Rep. prepared for Dome Petroleum Ltd., Gulf Canada Resources Inc. and the Polar Cont. Shelf Proj., 50 p.

Bearded seals were resident in the fast ice of Amundsen Gulf throughout the winter maintaining breathing holes in close association with ringed seals. Pupping occurred on the ice in early to mid-May. Haul-out occurred primarily between late April and ice break-up in late June or early July. The underwater vocal repertoire of bearded seals around Ramsay Island consisted of ascending- and descending-frequency trills and perhaps a groan. Vocalization rates were obtained for an undetermined number of seals around the ice camp between 20 April and 23 May and for two occasions in which a single bearded seal was recorded. A strong diel pattern in the rate of vocalization existed with a marked increase in rate between 2400 and 0600 hrs. Distance that bearded

seal calls travel in water was estimated to be at least 25 km based on simultaneous recordings at separate sites. No significant reduction or change in vocalization activity was seen during periods of snowmachine activity in the recording area. The quality of our recordings was affected by wind, which was a significant source of ambient noise throughout the investigation.

2569 CORNISH, B.J., and DICKSON, D.L. - 1985
Waterbird Surveys of McKinley Bay Northwest Territories, 1984; *Env. Can.*, Can. Wildl. Serv., Report prepared for Can. Wildl. Serv. and Ind. Affairs & North. Dev., March 1985, 68 p.

A monitoring study of waterbird abundance and distribution at McKinley Bay, NWT, was initiated in 1981 and has been continued annually since then. This report presents the results of aerial surveys conducted in 1984. The main objective was to gain baseline data on annual population fluctuations of moulting diving ducks prior to extensive development of the bay as a medium draft harbour base to support oil and gas production in the Beaufort Sea. Since 1982, Hutchison Bay was also surveyed as a control.

The aerial surveys in 1984 were carried out on August 3, 4 and 5. On August 3, when surveying conditions were the best, the number of diving ducks at McKinley Bay was estimated to be 17 183 ± 4739, while at Hutchison Bay on the same day, the estimated population was 17 311 ± 1178 diving ducks.

As in previous years of this study, scoter and Oldsquaw were by far the most common species of diving duck observed at both bays. Compared to the surveys from 1981 through 1983, at McKinley Bay considerably more scoters were counted in 1984, although this increase was not detected statistically. At Hutchison Bay, significantly more Oldsquaw were counted in 1984 than in other years ($p < 0.05$), while numbers of scoters decreased significantly in 1984.

At McKinley Bay, diving ducks were concentrated in the Atkinson Point area and at the south end of the bay, as in previous years. In 1984, about 94% of scoters were seen in these two areas, while Oldsquaw were frequently observed in other areas of the bay as well. Unlike other years, most of the divers seen in the Atkinson Point area were scoters.

Overall densities of birds using the terrestrial component at McKinley Bay were greater than at Hutchison Bay. The shallow lagoon system at the south end of McKinley Bay was especially important for Brant and Greater White-fronted Geese, while Tundra Swans were scattered on lakes and ponds in the area as well as on the lagoon. At both McKinley Bay and Hutchison Bay, the most common birds seen on the terrestrial component were the dabbling ducks.

2570 COTA, G.F. - 1985
Photoadaptation of high Arctic ice algae; *Nature*, vol. 315, no. 6016, pp. 219-222.

In aquatic systems, the layer that is suitable for positive net photosynthesis (the euphotic zone) is usually considered to extend from the surface down to the depth of penetration of 1% of the surface irradiance, which corresponds to ~ $15\mu Em^{-2}s^{-1}$ at solar noon during late summer in open waters in the high Arctic. In polar regions, vernal blooms of epontic algae (unicellular algae associated with the lower interface of sea ice whose photosynthetic characteristics are not well known) develop under conditions where they are only rarely or briefly exposed to light levels exceeding 1-2% of that incident at the surface. I report here that epontic algae from the Canadian Arctic show unusually high photosynthetic efficiencies normalized to pigment content, which increase with a decrease in the light levels at which the populations are growing. Photosynthesis was measurable at light intensities well below ambient (0.01% of surface irradiance). In the most shade-adapted populations under deeper snow cover, photosynthesis was optimal at light intensities close to the maximum ambient level, and inhibited at higher intensities. Furthermore, even after almost 2 months of exposure to elevated light levels (~ 3-4% of surface irradiance), biomass and productivity normalized to biomass were still lowest in algae from an area almost free of snow cover. Taken together these results indicate that epontic algae from the high Arctic can be considered as an obligate shade flora genetically constrained to very low photon fluxes.

2571 CUBBAGE, J.C., CALAMBOKIDIS, J., and RUGH, D.J. - 1984
Bowhead whale length measured through stereophotogrammetry; Final Report to National Marine Mammal Laboratory Seattle, Washington, Contract 83-ABC-00129, 71 p.

Between 7 August and 6 September 1983 portions of the Western Arctic stock of bowhead whales were photographed in the Canadian Beaufort Sea and Amundsen Gulf. The survey aircraft was equipped with cameras mounted on the wing-tips and on the belly of the aircraft. Measurements were made on stereo pairs of photographs from the 35 mm wing-tip cameras in three-dimensions (3-D) with a Traster Analytical Plotter. Additional whale measurements were made in 2-D from the single photographs taken with the 70 mm camera mounted in the belly of the aircraft. Photographic scale was calculated with readings from a radar-altimeter calibrated with measurement of an array of crosses photographed in the field. The mean length measurement, after calibration, of a 15 m long independent target (similar in size to a bowhead whale) was 15.06 m (N=25, SD=0.25 m). A comparison of our methods with other photogrammetric studies indicated the system we employed provided a high degree of accuracy. Improvements in accuracy from those in this study could be attained with: 1) a leaf-type shutter, 2) flight at lower altitude, and 3) 70 mm format cameras on the wing-tips.

The 3-D lengths of 153 bowhead whales photographed ranged from 5.71 m to 17.6 m. Length measurements in 2-D of whales photographed with the belly mounted camera indicated the 3-D measurements of the same whales were on the average 3% longer than the 2-D measurements of that whale. Lengths of bowhead whales varied significantly by location with the longer whales generally occurring further east. Based on the length frequency distributions of our sample 7.8 m was identified as the largest calf and we found between 10% and 14% calves in our measured sample. Lengths of bowhead whales accom-

panying calves were larger than 13.9 m with the exception of one whale that was 13.3 m. A node in the length distributions of bowhead whales occurred in the 8.25 m to 10.0 m range that was interpreted to be yearlings. This group represented 17% to 24% of our sample.

The bowhead lengths and proportion of calves we found were remarkably similar to those found in a similar photogrammetric study of bowhead whales conducted in the same area in 1982. The size distribution from both these studies, however, is not necessarily representative of the population because: 1) the geographic variation in sizes of bowhead whales present in the study area and 2) the lack of a survey strategy and information that would allow us to weigh the different sample components in relation to their proportion of the bowhead population.

2572 DALE, J.E. - 1985
Recent intertidal molluscs from the east-central coast of Ellesmere Island, Northwest Territories; *in* Current Research, Part B, Geol. Surv. Can., Paper 85-1B, pp. 319-324.

Twenty-nine species of recent molluscs were collected along the east coast of Ellesmere Island in the intertidal and nearshore area. All were cold water species adapted to habitation in a harsh intertidal environment, with ice cover 10 months of the year and exposure to ice gouging and melt runoff the remaining two months. Five species of molluscs were new to Ellesmere Island.

The greatest mollusc densities were found in the midtidal zone (approximately 1 m above lowest low tide) where large numbers of mobile gastropods dwelled. Larger sedentary forms were more common lower or in protected intertidal areas. Some of the recent species have existed in the area for more than 8000 years.

2573 DAWSON, M.R., and HICKEY, L.J. - 1984
Additional evidence on age disparity of High Arctic terrestrial biota during the Late Cretaceous and Early Tertiary; *Abstract in* Can. Paleontology and Biostratigraphy Seminar, Ottawa, Sept. 28-30, 1984

New evidence on distributional and biostratigraphic ranges of the Late Cretaceous to Early Tertiary floras and faunas in the Eureka Sound Formation comes from field seasons of 1982 and 1984 on Ellesmere Island, District of Franklin. Reptiles and mammals have now been recovered from exposures of the formation along Stenkul Fiord and on Swinnerton Peninsula. The vertebrate assemblages have a lower known diversity than those previously reported from the Bay Fiord-Strathconna Fiord area but, like those faunas, are limited to the uppermost unit (Member IV) of the formation. Compared to faunas from mid-latitudes, these vertebrates include a mix of Early and Middle Eocene forms. They first appear with a fossil megaflora of Late Paleocene aspect and continue into beds containing undoubted Eocene plants such as *Vinea, Zingiberopsis isonervosa,* and *Salvinia.*

Detailed mapping and paleontological sampling was done in 1984 in the lowest occurrence of the formation, Member 1, on Fosheim Peninsula, where the Eureka Sound Formation is in conformable contact with the marine Kanguk Formation. In addition to the Late Santonian to Early Campanian inoceramids previously reported in Member 1, new collections from this locality include cephalopods, pelecypods, and a marine annelid. This locality was precisely located in a measured stratigraphic section. About 50 meters higher in Member 1 a substantial megaflora containing an apparent ancestor of *Metasequoia* as well as *Cercidiphyllum* and a diverse assortment of platanoids of probable Campanian aspect was discovered.

The augmented floras and faunas of the formation strengthen the conclusions previously advanced that deposition of the Eureka Sound Formation began in Late Santonian to Early Campanian time, rather than in the Maastrichtian, on Axel Heiberg Island and central and southern Ellesmere Island. This evidence adds further corroboration to our conclusions of substantial age disparity of high latitude terrestrial floras and faunas with those of mid-latitudes.

2574 DEMASTER, D.P., and STIRLING, I. - 1983
The estimation of survival and litter size of polar bear cubs; *Int. Conf. Bear Res. and Manage.*, vol. 5, pp. 260-263.

The mark-recapture analyses that are currently used to study polar bears (*Ursus maritimus*) generally underestimate the average number of cubs per litter and assume that the annual survival of cubs is unity. In this paper, a relationship among the number of yearlings per litter and 2-year-olds per litter is used to derive the survivorship of yearlings, which is then used to solve for the number of cubs per litter. When this relationship was applied to published population data from North America, the resulting estimated survival rates of yearlings ranged from 0.70 to 0.75, and the estimated average number of cubs per litter was between 1.70 and 1.98. These findings indicate that current estimates of sustainable yield for polar bear populations may be in error because the reproductive rate of adult females was likely to be underestimated, and the survival rate of cubs of the year was likely to be overestimated.

2575 DICKSON, L. - 1985
Bird Surveys at King Point, Yukon in 1981 to Assess the Potential Impact of Development; *Env. Can.*, Can. Wildl. Serv., 113 p.

In 1979, Dome Petroleum Limited identified King Point as the most suitable location for development of a deep draft port to support future production of oil and gas in the Beaufort Sea. In order to assess the effect of such development on birds, the Canadian Wildlife Service conducted a field study at King Point from June to September in 1981. This report presents the results of the field study, as well as an evaluation of the impact of development at King Point on birds and recommendations for mitigative measures.

Aerial surveys were conducted at King Point on 19 June 1981 for nesting birds, 24 July for moulting and brood-rearing birds, and 3 September for fall staging birds. In addition, an aerial survey specifically for raptors nesting along the Trail River valley was conducted on 23 June, and one other survey specifically for fall staging Lesser Snow Geese was conducted on 3 September.

Ground surveys were done at four sites near King Point between 11 and 26 June to obtain more detailed information on nesting birds and habitat types.

The results of the study showed that the King Point area was regionally important to Lesser Snow Geese during fall migration in 1981. On 3 September, an estimated 42 300 snow geese or 10% of the entire western population of snow geese staged near King Point with the highest concentrations being along the Deep Creek valley.

According to the results of both the 1981 surveys and previous reports, the Babbage River delta and Phillips Bay support higher densities of nesting Glaucous Gulls, Tundra Swans, geese and shorebirds than elsewhere along the Yukon Coastal Plain. The delta is also locally important to moulting Tundra Swans, Northern Pintails, Oldsquaws and Red-breasted Mergansers, while offshore in Phillips Bay moulting scoters are common. During fall migration, the Babbage River delta is regionally important to staging shorebirds, Brant, Lesser Snow Geese and in some years, Greater White-fronted Geese. This and previous studies also indicate that the upper Babbage and Trail river valleys are prime habitat for cliff-nesting raptors.

Both the aerial and ground surveys in 1981 showed that nesting waterfowl, loons, gulls, terns, jaegers and shorebirds were more abundant within 10 km of the coast than further inland. Several species of passerine, rare elsewhere on the Yukon Coastal Plain, were found nesting in the Babbage River valley. Whimbrel and Stilt Sandpipers occurred in higher densities in wetlands near King Point than has been reported elsewhere on the Yukon Coastal Plain. Deep Creek supported unusually high densities of brood-rearing and moulting dabbling ducks, while the lagoon at King Point was locally important to moulting Oldsquaw.

Habitats surveyed near King Point were grouped into ten types and the nesting density of each bird species calculated for each habitat type. The highest densities and species richness of shorebirds occurred in Wet Sedge-Patterned Ground and Tussocky Tundra-Patterned Ground, the two graminoid habitat types with polygons found in the wetlands. Passerine species richness and densities were highest in the habitat types dominated by shrubs and dwarf shrubs. The habitat type least used was Tussocky Tundra, the habitat type which had no patterned-ground and which was dominated by tussocks of *Eriophorum* species growing on moist, flat to gently sloping terrain.

A deep draft port at King Point could result in impacts on birds from aircraft overflights, movements of surface vehicles, oil spills and loss of habitat from construction activity, particularly access roads, borrow pits and work pads. Important areas which should be protected from impacts include: 1) the area used by fall staging Lesser Snow Geese; 2) Phillips Bay and the Babbage River delta; 3) wetland habitat suitable for nesting shorebirds, loons, gulls, terns and waterfowl; and 4) the cliffs and bluffs along the Trail and Babbage rivers used by nesting raptors.

In addition, impacts from an influx of hunters, tourists and recreationalists, due to the improved road access, should be controlled.

2576 FURNELL, D.J., and SCHWEINSBURG, R.E. - 1984
Population dynamics of central Canadian Arctic Island polar bears; *J. Wildl. Manage.*, vol. 48, no. 3, pp. 722-728.

The range, abundance, and population dynamics of a hunted population of polar bears (*Ursus maritimus*) in the central Canadian Arctic Islands is described. Range was determined by tag returns and abundance by mark-recapture analysis. Population dynamics were based on family-group observations and life-table analysis using age samples obtained from teeth of live and killed bears. Based on 528 captures, including 60 recaptures, the abundance estimate was 1,100 animals with a mean annual survival rate of 0.87 and an overall annual natality rate of 0.47 cubs/reproductive age female/year. The population inhabits an area of approximately 45,000 km^2 and exists in four semidiscrete subgroups between which exchange occurs.

2577 GASTON, A.J., CHAPDELAINE, G., and NOBLE, D.G. - 1983
The growth of Thick-billed Murre chicks at colonies in Hudson Strait: inter- and intra-colony variation; *Can. J. Zool.*, vol. 61, no. 11, pp. 2465-2475.

Comparison of growth rates and fledging weights recorded for Thick-billed Murre chicks (*Uria lomvia*) by previous investigators shows that these parameters vary widely between studies. We measured growth rates and fledging weights at four colonies in the Hudson Strait area to examine the magnitude of variation both within and among colonies. Significant variations among years and among different areas of a single colony were detected but found to be less important than colony-specific factors in determining overall variation. A negative correlation between colony size and chick fledging weights suggests that colony size may be an important determinant of intercolony differences.

2578 GASTON, A.J., CHAPDELAINE, G., and NOBLE, D.G. - 1984
Phenotypic Variation among Thick-billed Murres from Colonies in Hudson Strait; *Arctic*, vol. 37, no. 3, pp. 284-287.

Thick-billed Murres (*Uria lomvia*) breeding in the Canadian Arctic are restricted to a small number of colonies, all comprising more than 10 000 pairs. Five of these colonies are scattered through Hudson Strait. We collected adult breeders at three of the colonies - Digges Island, Hantzsch Island, and Akpatok Island - and compared wing and bill measurements and body weights to look for inter-colony differences. Significant inter-colony differences were present for all measurements and a discriminant function analysis showed that some individuals fall completely outside the range of variation for the other colonies. Because of the presence of the Laurentide ice-sheet over Hudson Strait, the present colony sites could not have been occupied for more than 10 000 years. If the observed differences reflect differences in genotype then their evolution must have occurred over this period.

2579 GASTON, A.J., and NOBLE, D.G. - 1985
The diet of Thick-billed Murres (*Uria lomvia*) in west Hudson Strait and northeast Hudson Bay; *Can. J. Zool.*, vol. 63, no. 5, pp. 1148-1160.

We collected feeding adult Thick-billed Murres at several different localities within the foraging range of the colonies at Digges Sound through the breeding seasons in 1980, 1981, and 1982. Examination of prey remains from the stomach and foregut showed that the majority of birds contained prey covering a range of sizes from 0.01 to 47 g wet weight at ingestion. The total energy equivalent of prey found in the majority of stomachs was less than 10% of the birds' probable daily requirements. Comparison of species diversity of prey with that recorded for Thick-billed Murres in the high Arctic suggested that a greater range of prey is available in the low Arctic waters of Hudson Strait. We found little indication of consistent variation in prey occurrence among different feeding areas or within seasons. However, significant variation in diet occurred among years. Problems inherent in the method and the extent of variation among individual birds from the same sample make it difficult to make valid generalizations about the importance of different prey taxa in the diet of the murres.

2580 GASTON, A.J. - 1985
Energy invested in reproduction by Thick-billed Murres (*Uria lomvia*); *The Auk*, vol. 102, pp. 447-458.

Pelagic seabirds that lay single-egg clutches have been thought to invest less energy in reproduction than inshore-feeding species that rear more than one young. To examine this idea I calculated time and energy budgets for Thick-billed Murres (*Uria lomvia*) breeding at two large arctic colonies and compared their energy expenditure with that of a hypothetical group (shirkers) that was capable of feeding at the same rate but did not attempt any reproductive activity. The difference in energy investment between breeders and shirkers was strongly dependent on the average foraging range. I also compared my results with similar estimates for inshore-feeding Black Guillemots (*Cepphus grylle*). For the two Thick-billed Murre colonies, energy allocated to reproduction represented 30% and 24% of total energy expenditure during the breeding season. These values exceed the estimates for Black Guillemots. The amount of energy invested by Thick-billed Murres at the colonies considered probably is similar to that invested by other seabirds laying larger clutches and rearing heavier young.

2581 GASTON, A.J., CAIRNS, D.K., ELLIOT, R.D., and NOBLE, D.G. - 1985
A natural history of Digges Sound; *Env. Can.*, Can. Wildl. Serv., Rep. Ser. No. 46, 63 p.

Digges Sound separates East Digges Island from the northwestern tip of the Ungava Peninsula, Quebec. It has been famous for its huge colonies of Thick-billed Murres since the time of Henry Hudson. The birds and their eggs have been harvested by native peoples for hundreds, perhaps thousands, of years. During our work from 1979 to 1982 we estimated a population of 300 000 breeding pairs of murres on the cliffs flanking the sound. Smaller numbers of other marine birds also breed there. Black Guillemots are most numerous around the Nuvuk Islands and associated small islets. We estimated about 1000 pairs of Guillemots in the area. Three species of gulls breed, although the Herring Gull is confined to the area south and west of the sound. Iceland Gulls, estimated at 350 pairs scattered in eight colonies, do not occur otherwise south of Hudson Strait. Most of the approximately 180 pairs of Glaucous Gulls breed in close association with the murres.

There is a small colony of a few dozen Atlantic Puffins on Dome Island, to the south of West Digges Island. The nearest known breeding locality is in Labrador. A few Razor-bills, seen occasionally near the murre colonies, also breed. The species does not occur otherwise west of the mouth of Hudson Strait.

The murres take a wide variety of marine life, including small fish, of which the most important are arctic cod, snailfish, sandlance and capelin, and invertebrates, particularly amphipod and mysid crustacea. The chicks are fed almost entirely on fish. In comparison with Thick-billed Murres in the high arctic, those breeding at Digges Sound take a wider variety of prey species.

On East Digges Island, where we conducted most of our work, about 62% of breeding murres succeeded in rearing a chick each year. Most of the losses occurred at the egg stage, the principal cause being accidental dislodgement. During the chick-rearing period losses were small. Most of those that disappeared were probably taken by Glaucous and Iceland Gulls. Small numbers of adult murres were taken by Gyrfalcons, which nested on the colony in two years, Peregrine Falcons, and red foxes. Ravens took several thousand eggs, but the effect of these losses was probably negligible in relation to the total size of the colony. The several thousand eggs and adults removed annually by local people likewise probably have little effect on the population. However, unnecessary disturbance at the colony while eggs and chicks are present causes many losses and may have a more serious impact.

Aerial surveys carried out in July and August in northeastern Hudson Bay and western Hudson Strait showed that murres from the Digges Sound colonies often travelled over 100 km to feed. The most frequently used feeding area during most of 1981 and 1982 was to the southwest of Digges Sound between Mansel Island and the mainland. Murres were also seen feeding in large numbers off the Nuvuk Islands, almost exclusively in water more than 40 m deep. In contrast, Black Guillemots fed mostly in shallower water, taking benthic fish, particularly blennies, which did not form an important element in the murres' diet.

The Thick-billed Murres on Digges Island laid very large eggs in comparison with those recorded elsewhere. In spite of this the chicks grew very slowly and were much lighter when they left the colony than those measured at Prince Leopold Island, in the high arctic. We found consistent differences in the sizes of eggs laid and the growth rates of the chicks between different parts of the colony. The poor growth of the chicks was presumably related to low rates of feeding by the parents, and this probably resulted from the very long distances that the adults travelled to find food.

Despite the very large concentration of Thick-billed Murres at Digges Sound and throughout Hudson Strait, the seabird community of the area has few species compared with that of Lancaster Sound, lacking Northern Fulmars and Black-legged Kittiwakes. With a greater diversity of potential prey available in Hudson Strait and an apparent abundance of suitable colony sites, it is hard to construct an ecological explanation for why there are so few species of seabirds. This paradox provides a fertile field for speculation. Our inability to solve it emphasizes the exciting opportunities for research on fundamental problems of seabird ecology in the north.

2582 GILLMAN, D.V., and KRISTOFFERSON, A.H. - 1984
Biological Data on Pacific Herring (*Clupea harengus pallasi*) from Tuktoyaktuk Harbour and the Liverpool Bay Area, Northwest Territories, 1981 to 1983; *Fish. and Oceans*, Can. Data Rep. Fish. Aquat. Sci. no. 485, 26 p.

This study represents the initial step to determine the feasibility of establishing a commercial fishery for herring roe in the Tuktoyaktuk area, Northwest Territories. Pacific herring were captured with experimental gillnets in Tuktoyaktuk Harbour in May and June, 1981, and in June, 1982. Similarly herring were taken in the Liverpool Bay area in June, 1981, June and July, 1982, and June and September, 1983. Spawning apparently began when surface water temperature reached 2.5 to 3.5°C. Hazardous ice conditions in Tuktoyaktuk Harbour just prior to spawning suggest that this area is unsuitable for a roe harvest operation. More favourable conditions appear to prevail in the Fingers area of Liverpool Bay. Biological data (length, age, weight, sex, maturity, condition) from samples of herring taken during this study are presented in this report.

2583 GIROUX, J-F., BÉDARD, Y., and BÉDARD, J. - 1984
Habitat Use by Greater Snow Geese During the Brood-Rearing Period; *Arctic*, vol. 37, no. 2, pp. 155-160.

Observations of habitat use by the Greater Snow Goose (*Anser caerulescens atlanticus*) were conducted at Jungersen Bay, northern Baffin Island, from 27 July - 17 August 1981. Density of geese using the study area was estimated at 425 birds·km^{-2}. The average of 2.8 young per family did not change during our study. Nonbreeding geese were first observed in flight on 1 August and were seen regularly until 13 August. Three types of habitat used by geese during the brood-rearing period were distinguished: tidal marshes dominated by *Carex subspathacea* and *Puccinellia phryganodes*; wet moss-covered meadows with up to 5 cm of standing water, dominated by *Carex stans, Dupontia fisheri, Calamagrostis neglecta,* and *Arctagrostis latifolia*; and, around ponds, bands of vegetation 1-2 m wide dominated by *Carex stans*. The three most important species of monocots grazed by geese were *Puccinellia phryganodes, Carex subspathacea,* and *C. stans*. It is unlikely that habitat and food resources are limiting factors for Greater Snow Geese in the High Arctic during the brood-rearing period. We suggest that potential breeding areas for this species be identified and given special protection.

2584 GRAY, D.R. - 1983
Interactions between wolves and muskoxen on Bathurst Island, N.W.T., Canada; *Acta Zool. Fennica*, vol. 174, pp. 255-257.

Twenty-one interactions between wolves *Canis lupus* and muskoxen *Ovibos moschatus* were observed in Polar Bear Pass, Bathurst Island, N.W.T., during a study of the social behaviour of muskoxen between 1968 and 1979. Observations were made at all times of the year including one complete winter. Single wolves or packs of up to seven individuals approached single muskoxen or herds of up to 27 directly with little or no stalking. The reaction of the muskoxen included rubbing the preorbital glands against the foreleg, stampede, formation of a defence line or circle, and charging the attacking wolves. Three observed encounters resulted in kills. No injuries to wolves were noted in attacks which lasted from a few minutes to 2½ hours. Only four encounters between wolves and solitary muskoxen were seen. Most muskox behaviour patterns seen during encounters with wolves also occurred in interactions with man and Peary caribou, and between muskox bulls. Of those behaviour patterns, the rubbing of the preorbital gland and the pressing together into a defence line or circle are apparently unique. Wolves spend more time in killing muskoxen than in killing Peary caribou. Wolves are more likely to be successful when a muskox herd stampedes.

2585 GRAY, D.R. - 1984
Dominance fighting in muskoxen of different social status; *Univ. Alaska*, Biol. Spec. Rep. no. 4, pp. 118-122.

During a study on social behavior of muskoxen (*Ovibos moschatus*) on Bathurst Island, NWT, between 1968 and 1978, 40 dominance fights between male muskoxen were observed. Dominance fights consisted of preliminary displays, backing up with head-swinging, and galloping forward by both bulls with at least 1 head-on clash. Other behavior patterns associated with fights included roaring, gland-rubbing, horning, pawing, head-tilting, hooking, and chasing. Such fights occurred from May to September. Fights lasted up to 50 min, those of longest duration occurring in July and August. One case of injury was noted during an encounter, though 1 carcass with a possible fight-inflicted injury was found. Interactions between herd bulls and solitary bulls (N=12) were of longer duration and had more clashes than those between bulls from the same herd (N=17), or between herd bulls from 2 different herds (N=11). In almost all fights with solitary bulls, the herd bull was the apparent winner. In fights between bulls within a herd, both combatants usually remained in the herd. Dominance fights seldom produced a new solitary bull.

2586 GREENE, C.R. - 1985
Characteristics of waterborne industrial noise, 1980-1984; *in* Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84. Ed. W.J. Richardson. Chapter by Greeneridge Sciences, Inc., in Unpubl. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan TX, for U.S. Minerals Management Service, Reston, VA, pp. 197-253.

This section documents underwater sounds to which bowhead whales were exposed during disturbance experiments

and other behavioral observations in the Canadian Beaufort Sea, 1980-84. Data were collected with calibrated low noise hydrophones suspended 3-18 m beneath a sparbuoy, and with sonobuoys dropped and monitored from the aircraft used to study bowhead behavior. Results are for hydrophone depth 9-18 m unless otherwise stated. Laboratory analysis included power spectrum analyses of continuous sounds, and waveform and peak signal analyses for seismic survey pulses. Overall levels are given for the 20-1000 Hz band, which includes most components of the industrial and bowhead sounds.

2587 HAMMILL, M.O., and SMITH, T.G. - 1984
Ecology of the ringed seal in Barrow Strait 1984; A Progress Rep. to Petro-Canada Ltd., Esso Resources Canada Ltd., and Dome Petroleum Ltd., 14 p.

This reports on the first of a three year Ph.D. research program aimed at documenting the range of variability in the vital parameters and physiological status of ringed seals (*Phoca hispida*) resident in the Barrow Strait area of the high Arctic.

The possibility of the movement of LNG and oil carrying ships through Barrow Strait and Lancaster Sound has raised questions concerning their possible effects on ringed seals, inhabiting the stable fast ice of the area.

A prominent feature of this area is the large annual variation in the extent of the fast ice cover. This variation in ice cover is expected to have a major effect on the numbers, distribution, reproduction and physiological status of resident ringed seals. In the western arctic the ringed seal has shown considerable variation in its annual recruitment and in total numbers.

The aims of this study are to: 1) measure the density and distribution of seals in Barrow Strait and to relate these to variations in physical features such as snow depth, ice thickness and surface features, 2) document the age structure, reproductive and health status of the population, 3) relate ringed seal vocalizations quantitatively and qualitatively to ringed seal density and distribution, 4) measure the thermal benefits of ringed seal subnivean structures.

2588 HAVAS, M., HUTCHINSON, T.C., and LIKENS, G.E. - 1984
Effect of low pH on sodium regulation in two species of *Daphnia*; *Can. J. Zool.*, vol. 62, no. 10, pp. 1965 - 1970.

The effect of low pH on sodium-22 influx and outflux of *Daphnia magna* and *Daphnia middendorffiana* was assessed. Experiments were conducted in both hard and soft water with experimental pHs ranging from 3.5 to 8.0. In hard water, at and below pH 4.0, there was a net loss of sodium from both species. The rate of sodium loss (outflux) increased significantly, while the rate of uptake (influx) remained constant at pH 4.0 compared with the reference pH 8.0. Only at extremely low pH (pH 3.5) was sodium influx inhibited in hard water. In soft water *D. magna* responded quite differently. Sodium influx was inhibited by 23% at pH 5.0 and by 69% at pH 4.5 compared with the control (pH 6.5). Sodium outflux was stimulated to 125% of the control at pH 4.5. The net loss of sodium in soft water was due to both an increase in sodium outflux and a decrease in sodium influx, while in hard water the effect was primarily on sodium outflux. *Daphnia magna* and *D. middendorffiana* have problems with sodium regulation below pH 5.5 in soft water and below pH 4.5 in hard water, which indicates that they are considerably more sensitive to low pH in soft water than in hard water.

2589 HAY, K.A. - 1984
The Life History of the Narwhal (*Monodon monoceros* L.) in the Eastern Canadian Arctic; unpub. Ph.D. thesis, McGill Univ., 255 p.

The life history of the narwhal *Monodon monoceros* was studied utilizing animals captured by the Inuit in northern Baffin Island. Segregation by age and sex within this population is evident, with summering groups consisting of mature females with calves, immature and maturing males, and large mature males. The diet consists of arctic cod, shrimp, and squid during June and July, but feeding activity declines markedly during the open-water months of August and September. Growth layers in the unerupted teeth and periosteal zone of the mandible were found to be related to age but absolute rates of accumulation of these layers are uncertain. The maximum life span is estimated to be 40 to 50 years. Male narwhals, which mature sexually at lengths exceeding 390 cm and at 16-17 growth layers, display protracted maturation and a possible annual cycle of spermatogenesis. Females, which mature sexually at lengths exceeding 340 cm and at 12 growth layers, are seasonally polyoestrous, experiencing up to four consecutive ovulations during the breeding season. The gestation period is estimated to be 15.3 months. The season of conceptions is March to May and calving occurs during July and August. Since the lactation period exceeds 12 months, the interval between successive conceptions is usually three years, but about 20% of females conceive at the first breeding season following birth of their calves. The annual population birth rate is calculated to be about 0.07. The basic life history features of the narwhal are similar to those of other medium-sized toothed whales.

2590 HEWITT, R.A., and DALE, J.E. - 1984
Growth increments of modern *Mya truncata* L. from the Canadian Arctic, Greenland, and Scotland; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 179-186.

A preliminary examination of modern *Mya truncata* L. from numerous arctic locations in Canada and Greenland, as well as from boreal sites in Scotland, indicates that this species can live to a maximum of 40 years. These age estimates were based on counts made from thin sections. Counts made in the umbonal region of the inner shell layer and beside the ligamental pit of the chondrophore proved more reliable than estimates based on external growth ridges.

2591 KEMPER, J.B., and MITCHELL, E.D. - 1978
Implication for management of narwhal: age determination techniques; *Abstract in* Proc. Inter. Conf. on

determining age of Odontocete cetaceans, Scripps Inst. Oceanography, La Jolla, California, Sept. 5-7, 1978, p. 27.

Recent studies of age determination in narwhals have centered around counts of growth layers in the vestigial, unerrupted upper right tusk in males and females. These show growth layers apparently up to the age of sexual maturity, then occlude at the base. In males, the errupted tusk can be examined for that portion of the growth history subsequent to sexual maturity, but no such possibility exists using dentinal structures for females.

A complete record of individual growth may, or may not, occur or be readible in the large, errupted tusk of sexually mature males. The Canadian Arctic Inuit hunt for narwhals is becoming increasingly a trophy hunt, with emphasis on the mature, tusk-carrying males. Unless purchased in the field at current ivory market prices, sufficient numbers of these tusks may not be available for scientific studies of the age structure of the male kill. Even if sufficient tusks were purchased to construct an age-length or age-weight curve for males, the problem would remain for females.

There is a possibility that the social structure of the narwhal is as complex as that inferred for the sperm whale, *Physeter catodon*. If this is the case, the present removal of large-tusked, presumably socially mature males, may have greater future impact on female pregnancy rate and population size than that represented only by numerical removal (landed catch plus loss rate) in the present Inuit harvest period.

We conclude that other methods of determining age should be considered in studies directed towards management of narwhal populations. These might include: correlation of tusk weight with age; growth layers in cementum or other hard tissues of the body (e.g., lamellar bone of the skull, periotic, and tympanic).

2592 KERBES, R.H. - 1982
Lesser snow geese and their habitat on west Hudson Bay; *Naturaliste can.*, vol. 109, pp. 905-911.

A large subpopulation of lesser snow geese (*Anser caerulescens caerulescens*) breeds on a coastal plain of approximately 5,000 km^2 on west Hudson Bay in the vicinity of Eskimo Point, N.W.T. Inventories of the nesting birds with aerial photography showed a continuous decline from 195,000 pairs in 1973 to 131,000 in 1980. Aerial surveys in 1977, 1978 and 1980 showed inland expansion of summer range. Over-grazing of summer range is the probable cause of those changes, although prairie drought in 1977 and 1980, adverse spring weather with late snow-cover on the nesting grounds in 1978, and avian cholera in summer 1979 also are implicated. Apparently, a rapid increase in population prior to 1973 led to over-grazing of preferred coastal sedge habitats. Consequently, the geese spread to more inland habitats which are considered less desirable for summer feeding. Management implications are discussed.

2593 KINGSLEY, M.C.S., STIRLING, I., and CALVERT, W.A. - 1981
Habitat preferences and distribution of ringed seals in the Canadian Arctic Archipelago; *Abstract in* Proc. 4th Biennial Conf. Biol. Marine Mammals, San Francisco, Calif., Dec. 14-18, 1981, p. 70.

Surveys were flown to count ringed seals hauled out on the sea ice in the early summers of 1980 and 1981 over a wide area of the central Canadian high Arctic. The distribution of seals was similar in the two years. Strata differed widely in density. Seals appeared to respond most to the age of the ice, with multi-year ice avoided and one-year ice preferred. Densities were low on floe ice, and higher on fast or cracking ice. Repeatability of surveys was checked by comparing observers and found to be good.

2594 KINGSLEY, M.C.S. - 1984
The abundance of ringed seals in the Beaufort Sea and Amundsen Gulf, 1983; *Fish. & Oceans*, Can. Manuscr. Rep. Fish. Aquat. Sci., 1790 p.

The third in a series of surveys to monitor the abundance and distribution of the ringed seal (*Phoca hispida*) was flown in the Beaufort Sea, Amundsen Gulf and Prince Albert Sound from 19 through 27 June 1983.

At the time of the survey, the Beaufort Sea was partially open, the fast ice was thin and appeared ready to break up, and the cover in the floe ice area was low. Amundsen Gulf and Prince Albert Sound were covered with fast ice.

Densities of seals in Amundsen Gulf and in Prince Albert Sound were similar to those of 1982. In the Beaufort Sea, the density of seals on the floe ice was similar to that estimated in 1981; the density on fast ice was higher, apparently absorbing an overflow from the lesser cover of floe ice. The total visible population has been similar over the three years.

Higher density in proximity to active industrial sites was indicated by results of regression analysis.

2595 KINGSLEY, M.C.S., STIRLING, I., and CALVERT, W. - 1985
The Distribution and Abundance of Seals in the Canadian High Arctic, 1980-82; *Can. J. Fish. Aquat. Sci.*, vol. 42, pp. 1189-1210.

Surveys of hauled-out ringed seals (*Phoca hispida*) and bearded seals (*Erignathus barbatus*) were flown in 1980 and 1981 over Jones Sound, the Sverdrup Basin, the channels between the Parry Islands, the Parry Channel, Prince of Wales Strait, and northern Amundsen Gulf. Part of the survey was flown again in 1982. Ringed seals were most numerous in Barrow Strait and Wellington Channel, their density decreasing westward and northward. Their preferred habitat was annual ice, fast or cracking, of high cover; they avoided deep water. Bearded seals were seen in low numbers in early-opening areas, preferring floe or rotten ice of moderate or low cover over shallow water.

2596 KORCZYNSKI, R.E. - 1985
Intersexuality in the Arctic Isopod *Mesidotea (=Saduria) sibirica*; *Arctic*, vol. 38, no. 1, pp. 68-69.

An intersex individual of the isopod *Mesidotea sibirica* was found among 50 specimens taken from collections obtained in Pauline Cove, Herschel Island, Yukon Territory, in the summer of 1975. This is the first such intersex form reported for *M. sibirica*. Intersexuality has not been reported previously among isopods of the genus *Mesidotea*.

2597 LAWRENCE, M.J., LACHO, G., and DAVIES, S. - 1984
A Survey of the Coastal Fishes of the Southeastern Beaufort Sea; *Fish. and Oceans*, Can. Tech. Rep. Fish. Aquat. Sci. no. 1220, 188 p.

Fish samples were collected with gillnets, beach seines and hoopnets during surveys conducted in the spring, summer and fall open-water seasons in 1978, 1979 and 1980 along the southern Beaufort Sea coast between Richards Island to the west and Liverpool Bay to the east. Samples taken were analyzed to determine, on a species basis, seasonal distribution and relative abundance, age- and length-frequency distribution, sexual maturity, growth and feeding habits. In conjunction with fish sampling, depth, temperature, salinity, TDN, TDP, chlorophyll a, suspended particulate concentration and other physical and chemical environmental parameters were measured to delineate fish habitat features. Surface water quality within the estuary was variable depending upon distance from the Mackenzie River, time since spring freshet, wind velocity, local bathymetry and exposure of sites to wind and currents. The ranges for some water quality features for spring, summer and fall sampling periods respectively were as follows: Temperature (°C) 1.9-14.0, 7.3-13.9, 1.9-8.5; Salinity 0.02-30.74, 0.04-26.94, 0.06-30.53; TDN ($\mu g \cdot L^{-1}$) 130-460, 190-530, 150-340; TDP ($\mu g \cdot L^{-1}$) 3.1-41.7, 3.8-43.5, 4.1-11.0; chlorophyll a ($\mu g \cdot L^{-1}$) 0.4-4.1, 0.3-5.0, 0.5-3.3.

Surface water quality features for 23 lakes in the study area were also determined. Ranges over spring, summer and fall respectively are as follows: Temp (°C) 9.5-13.5, 8.8-15.9, 1.8-5.1; Conductivity ($\mu Siemens \cdot cm^{-1}$) 80-221, 96-219, 104-281; TDN ($\mu g \cdot L^{-1}$) 200-430, 190-710, 220-570; TDP ($\mu g \cdot L^{-1}$) 3.8-9.8, 3.4-42.2, 4.3-43.1; chlorophyll a ($\mu g \cdot L^{-1}$) 1.25-5.11, 0.2-5.7, 1.0-11.0.

Twenty-one species of fish were caught within the study area. Fourhorn sculpin and arctic flounder were the most abundant and widely distributed marine species, while Arctic and least cisco were the most abundant and widely distributed anadromous fish. Amphipoda, Mysidacea, Isopoda, Pelecypoda and fish were principal food items of coastal fish species.

Broad whitefish, least cisco and lake whitefish accounted for 84% of the total gillnet catch in study area lakes. Gastropoda, Amphipoda and Notostraca were the most important food items of these species. Inconnu, rainbow smelt and Arctic cisco, species common to the Mackenzie estuary, were absent from coastal freshwater drainages.

Most of the coregonid species present in the eastern Mackenzie estuary during the open water period were in a non-spawning condition. It is postulated that the spawners had migrated upstream to spawning sites within the Mackenzie River drainage prior to each year's spring sampling.

Two varieties of least cisco are described: an anadromous form, found principally in the estuary and a larger, faster-growing freshwater form, found exclusively in the small, freshwater lake and stream systems.

A number of streams of the study area were found to support large runs of coregonids (broad whitefish in particular) indicating that freshwater systems are of major importance to anadromous whitefish production in the region. Streams studied were too shallow to provide overwinter habitat for fish. Lake overwinter habitat appears to be less available on Tuktoyaktuk Peninsula than on Richards Island.

Many bays and lagoons of the study area were found to serve as rearing areas for juvenile (0+ and 1+ year old) coregonids and smelt which are presumed to be flushed downstream from Mackenzie River spawning locations. Juvenile fourhorn sculpins, flounders and Pacific herring also utilize the nearshore embayments.

2598 LGL ECOLOGICAL RESEARCH ASSOCIATES, INC. - 1985
Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84. Unpubl. Rep. for U.S. Minerals Management Service, Reston, VA, Ed. W.J. Richardson, 306 p.

The bowhead whale, *Balaena mysticetus*, inhabits cold northern waters. All populations were exploited heavily by commercial whalers in the 18th or 19th centuries, and all were seriously reduced. Bowheads are considered endangered under U.S. legislation.

Bowheads of the Western Arctic (= Bering Sea) population, the one group occurring in U.S. waters, winter in the Bering Sea, summer in the eastern Beaufort Sea, and migrate around western and northern Alaska in spring and autumn. The size of this population was much reduced by intensive commercial whaling between 1848 and 1914. The extent of the summer range was apparently also much reduced. A subsistence harvest continues annually in Alaska. The International Whaling Commission's current 'best estimate' of the stock size is 3871 individuals.

The spring migration of Western Arctic bowheads is close to shore in the Chukchi Sea, but well offshore in the Alaskan Beaufort Sea. Thus, the eastward spring migration through the Alaskan Beaufort Sea in April-June is well north of the area of oil exploration near the coast. However, during the westward autumn migration in August-October, many bowheads occur close to shore, within or near some offshore oil leases.

From June to early September, the great majority of the Western Arctic bowheads are in Canadian waters. Intensive offshore oil exploration began several years earlier in the Canadian part of the Beaufort Sea than in the Alaskan portion. Nearshore drilling from artificial islands has been underway in the south-central part of the summering area since about 1972, with drillships in use farther offshore since 1976. Seismic exploration began there earlier and still continues. The main area of offshore drilling is north of the Mackenzie Delta and the western Tuktoyaktuk Peninsula. Summering bowheads are sometimes common in and around that area.

2599 LUNN, N.J. - 1985
The ecological significance of supplemental food to polar bears on land during the ice-free period in western Hudson Bay; unpub. M.Sc. thesis, Dept. Zoology, Univ. Alberta, 95 p.

During the summers and falls from 1981 to 1983 polar bears were studied in the Churchill, Manitoba area to examine how bears have evolved to deal with extended periods of time away from their primary food source

and also to determine if supplemental food sources were important. Once ashore, bears segregated by age and sex class; females with cubs and pregnant females moved inland into a denning area, while single bears, especially adult males, remained along the coast. Bears along the coast were observed engaged in 870 hours of activity. Bears were inactive and fed very little. Evidence from analysis of blood samples taken from bears in the denning area suggested that they were also not feeding. By remaining inactive, polar bears are able to minimize energetic demands and also minimize the chance of hyperthermia.

After approximately two months ashore, a small proportion of the bear population arrived in the Churchill dump and began to feed. Bears were observed engaged in 1215 hours of activity. The dump was used mainly by females with cubs and by subadults. The data indicated that individual need and the learning of its location were major factors determining which bears used the dump. However, adult male bears did not use the dump even though they may have used it as a cub or subadult.

Those bears that fed in the dump were significantly heavier than their counterparts that did not feed while ashore. There was no evidence that bears that fed in the dump had either reproductive or survival advantages over bears that were not feeding. My conclusion is that polar bears will use supplemental food sources if they are readily available or if they have learned its location; however, most polar bears do not need to.

2600 McCORMICK, K.J., ADAMS, M.E., STEPHENSON, C.J., and GOODMAN, A.S. - 1984
Key migratory bird terrestrial habitat sites in the Northwest Territories; *Can. Wildl. Serv.*, Yellowknife, Habitat Mgmt. Sec. Tech. Rep. no. 84-6, 175 p.

Adequate habitat (both quantity and quality) is fundamental to the conservation of all wildlife species. Therefore, consistent with the above legislation and the Federal Policy on Land Use (1981) the CWS identifies, protects, and manages lands of particular ecological value to wildlife as part of the Canadian national heritage. This document is a first step in identifying those sites within the Northwest Territories (NWT) which are essential to the welfare of various migratory bird species in Canada. It will serve as a statement of CWS interest in these sites and is offered as a guide to the conservation efforts of other agencies and organizations with interests in the NWT.

2601 MILLER, F.L., and GUNN, A. - 1984
Muskox defense formations in response to helicopters in the Canadian High Arctic; *Univ. Alaska*, Biol. Pap. Spec. Rep. no. 4, pp. 123-126.

In the summers of 1976 and 1977 we observed the grouping of muskoxen (*Ovibos moschatus*) into herd defense formations in response to helicopter overflights on northeastern Prince of Wales Island, Northwest Territories. Of the 973 muskoxen that walked, cantered, or galloped toward each other on 111 occasions, 727 (74.7%) came together and assumed defense formations in response to the helicopter overflights. There was no significant relationship ($P>0.5$) between the gait used and the subsequent participation by those muskoxen in defense formations. The gaits used partly reflected the distances between herd members at the onset of the helicopter overflights. Durations of defense formations in response to helicopter overflights were relatively brief; mean, 5.2±2.46 min (SD); range, 2 to 12 min. We did not see any muskoxen take up defense formations after the departure of the helicopter.

2602 MILLER, F.L., GUNN, A., and BROUGHTON, E. - 1985
Surplus killing as exemplified by wolf predation on newborn caribou; *Can. J. Zool.*, vol. 63, pp. 295-300.

We searched for newborn calf carcasses of migratory barren-ground caribou (*Rangifer tarandus groenlandicus*) in June 1982 in the Northwest Territories. On 17 June, we found 34 calves killed by wolves (*Canis lupus*), clumped in a 3-km^2 area. The calves had been killed apparently within minutes of each other and about 24 h before being found. Wolves had not fed on 17 of the carcasses and had only partially eaten the other 17. Ground observations illustrate the speed of and efficiency with which wolves can kill calves: a single wolf killed three calves on one occasion and three and possibly four calves on a second occasion at average kill rates of 1 calf/min, and 1 calf/8 min or 1 calf/6 min between the first and last deaths. We attributed the surplus killing of newborn caribou calves to their high densities and their vulnerability on the calving grounds. We recommend that a distinction be made between "surplus killing" and "excessive killing" by predators.

2603 MITCHELL, E., and KEMPER, J.B. - 1978
Narwhal with lower jaw tusk; and aspects of hard tissue deposition in narwhals after sexual maturity; *Abstract in* Proc. Inter. Conf. on determining age of Odontocete cetaceans, Scripps Inst. Oceanography, La Jolla, California, Sept. 5-7, 1978, p. 29.

During the summer of 1978 ice edge hunt by Inuit for Narwhals (*M. monoceras*) in Pond Inlet, Baffin Island, Northwest Territories, an adult male, 4.52 m in overall length, was taken with a normal 1.95 m-long, left maxillary tusk and a small, ventro-externally-curved, lower right, dentary tusk, 0.30 m in curved length. Both of these tusks, the upper right vestigial tusk, and some bony tissues from the upper and lower jaws of this male, as well as comparable materials from a normal male, 4.36 m in overall length, taken in the same hunt were examined for growth layers. These samples represent one of the first attempts to determine age of sexually mature male Narwhals.

2604 MITCHELL, E.D., and REEVES, R.R. - 1982
Factors affecting abundance of bowhead whales *Balaena mysticetus* in the Eastern Arctic of North America, 1915-1980; *Biol. Conserv.*, vol. 22, pp. 59-78.

The severely depleted bowhead whale *Balaena mysticetus* has failed to recover from overexploitation during the 18th and 19th centuries in the Eastern Arctic. Although commercial whaling for bowheads ended in this region about 1915, bowhead whaling by native people has continued until recently in parts of the Eastern Arctic. Low-level but persistent hunting by Inuit (Eskimos) may have inhibited bowhead population increase. Two natural

mortality factors can be documented - ice entrapment and predation by killer whales *Orcinus orca*. There is little direct evidence of ice-related mortality but a strong circumstantial argument that ice conditions affect survival. Killer whales are known to prey on most species of large whales, and we believe bowhead whales and right whales *Eubalaena glacialis* are especially vulnerable. The bowhead's apparent failure to recover in the Eastern Arctic may be due to a combination of continued low-level hunting, habitat instability, and predation. Complete protection from all forms of hunting is necessary to ensure the bowhead's survival. Environmental disturbances due to industrial development in the Arctic may have direct and indirect impact on bowhead habitat and behaviour, creating an urgent need for further study.

2605 MITCHELL, E. - 1982
Canada Progress Report on Cetacean Research June 1980 to May 1981; *Rep. Int. Whal. Comm.*, no. 32, pp. 161-169.

Studies continued on the analysis of data and on previous biological collections from northwest Atlantic blue, fin, sei, minke, humpback and sperm whales. Related work on the history of exploitation of severely depleted species of cretaceans continued with emphasis on bowhead, humpback and right whales. Research on Newfoundland whales emphasized aerial surveys and studies of cetacean net-entanglements in fishing gear.

Research on Arctic cetaceans included: surveys of beluga and bowhead; behaviour studies of beluga in Cunningham Inlet; compilation of catch-statistics; and work on the biology of narwhals.

In the North Pacific, research continued on the population dynamics and pod-specific vocalization patterns of killer whales off British Columbia.

2606 O BRIAIN, M. - 1984
Irish Brent Goose Expedition, Bathurst Island, Northwest Territories, Canada, 31 May - 19 August 1984; Preliminary Rep. to Polar Cont. Shelf Proj., 9 p.

The population of light-bellied brent geese which winters almost exclusively in Ireland represents a small yet geographically distinct breeding stock in the High Arctic of north-east Canada and Greenland. As part of a continuing programme of studies on the biology of these geese, a team of six Irish biologists spent almost three months investigating their summer ecology and behaviour on Bathurst Island.

2607 PEDDER, A.E.H. - 1985
Lochkovian (Early Devonian) rugose corals from Prince of Wales and Baillie Hamilton islands, Canadian Arctic Archipelago; *in* Current Research, Part B, Geol. Surv. Can., Paper 85-1B, pp. 285-301.

Lochkovian rugose corals from the Canadian Arctic Archipelago are illustrated for the first time, *Tryplasma* sp. and *Lythophyllum thorsteinssoni* sp. n. are described from the *delta* or *pesavis* Zone, in the upper member of the Drake Bay Formation on northwestern Prince of Wales Island. *Adinophyllum smithi* gen. et sp. n. (family Mucophyllidae) is described from beds equivalent to either the *eurekaensis* or *delta* Zone of the same member and region. *Stylopleura julli* Pedder, *Moehlophyllum* sp., *Lekanophyllum* sp. and *Lyrielasma* sp. are illustrated and discussed from beds equivalent to the *eurekaensis* Zone, in the middle unit of the Sophia Lake Formation on eastern Baillie Hamilton Island. Corals from all three locations are well dated on evidence provided by brachiopods, trilobites, conodonts and graptolites. The unnamed species of *Moehlophyllum* and *Lekanophyllum* are the oldest known representatives of these genera.

2608 PERCY, J.A. - 1983
Distribution of Arctic Marine Isopods of the *Mesidotea* (=*Saduria*) Complex in Relation to Depth, Temperature, and Salinity in the Southern Beaufort Sea; *Arctic*, vol. 36, no. 4, pp. 341-349.

Three benthic isopods of the *Mesidotea* (=*Saduria*) complex are common in the coastal waters of the southern Beaufort Sea. Their relative distribution in relation to water depth, temperature, and salinity was studied by means of 146 trawl, grab, and trap samples. *Mesidotea entomon* is restricted to the warm, brackish nearshore estuarine zone, in water depths of less than 10 m. *M. sibirica* is most commonly encountered at intermediate depths of 5-25 m. *M. sabini* is the most common marine form, occurring at depths from 10 to 441 m. This distribution pattern is similar to that reported for these species in the European Arctic.

Salinity fluctuations caused by wind-induced shifts in the location of the river plume, and the occurrence of deep, high-salinity water close to shore, result in overlaps in distributions of the isopods in some areas adjacent to the delta.

2609 RAMSAY, M.A., and STIRLING, I. - 1984
Interactions of wolves and polar bears in northern Manitoba; *J. Mamm.*, vol. 65, no. 4, pp. 693-694.

Wolves (*Canis lupus*) have been observed chasing brown bears (*Ursus arctos*) and black bears (*U. americanus*) and at least one case of wolves killing a denning female black bear and her cubs has been reported. Conversely, bears occasionally usurp prey from wolves, and some wolves may be killed in the process.

2610 REED, A., and DUPUIS, P. - 1983
Ivory Gulls, *Pagophila eburnea*, Nesting on the Brodeur Peninsula, Baffin Island, N.W.T.; *The Canadian Field-Naturalist*; vol. 97, no. 3, p. 332.

Two small colonies of Ivory Gulls, *Pagophila eburnea*, were found on the northwest portion of the Brodeur Peninsula, Baffin Island, in August 1981. This is the first confirmed observation of nesting on the Brodeur Peninsula, an area long believed to harbour breeding Ivory Gulls.

2611 RICHARDSON, W.J., GREENE, C.R., and WÜRSIG, B. - 1985
Project rationale and design; *in* Behavior, disturbance responses and distribution of bowhead whales *Balaena*

mysticetus in the eastern Beaufort Sea, 1980-84. Ed. W.J. Richardson, Unpubl. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA, pp. 1-11.

2612 RICHARDSON, W.J., WELLS, R.S., and WÜRSIG, B. - 1985
Disturbance responses of bowheads, 1980-84; *in* Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84. Ed. W.J. Richardson, Unpubl. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA pp. 89-196.

This report describes the behavior of bowhead whales near actual or simulated industrial activities in the Canadian Beaufort Sea. In the latter experiments we compared behavior of specific whales before, during and after exposure to simulated industrial activity.

2613 RICHARDSON, W.J., DAVIS, R.A., EVANS, C.R., and NORTON, P. - 1985
Distribution of bowheads and industrial activity, 1980-1984; *in* Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84. Ed. W.J. Richardson, Unpubl. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA, pp 255-306.

This section summarizes seasonal and year-to-year trends in the summer distribution of bowheads during 1980-84. It identifies locations where bowheads tended to concentrate, documents the locations of offshore industrial operations within the summering area, and discusses whether any year-to-year changes in distribution are attributable to oil exploration. Sightings of bowheads during all studies in the Canadian Beaufort Sea in mid-late summer of 1980-84 are mapped by 10-d period. Other maps show sites of offshore drilling, dredging, boat and helicopter traffic, seismic lines, and ice conditions. The 'main industrial area' is off the Mackenzie Delta, and includes island construction, drilling, dredging, and intensive boat and helicopter traffic. Seismic exploration occurs over a wider area.

2614 SCHWEINSBURG, R.E., SPENCER, W., and WILLIAMS, D. - 1984
Polar Bear Denning Area at Gateshead Island, Northwest Territories; *Arctic*, vol. 37, no. 2, pp. 169-171.

A survey during 1977 found that the Gateshead Island area, Northwest Territories, had 9 confirmed and 10 suspected polar bear dens. The importance of the area for polar bear reproduction was confirmed during a survey in 1982 when 15 dens were found, 10 of which were identified as maternity dens. The area should be protected from human intrusion.

2615 SMITH, T.G. - 1984
Beluga: critical estuary study; Project Rep., World Wildl. Fund Canada, Whales Beneath the Ice Program, McGill Univ., Macdonald Campus, Dept. Renewable Resources, Ste. Anne de Bellevue, Quebec, 119 p.

Belugas, or white whales, *Delphinapterus leucas*, are small arctic toothed cetaceans found throughout the north polar regions. In Canada five major stocks exist in the arctic plus one discrete southern population in the Saguenay River-St. Lawrence estuary.

In the arctic, belugas spend the winter in areas of open water near the edge of broken pack ice. As the ice disperses during the spring and summer months they migrate from their wintering areas eventually ending up in certain river estuaries where they congregate in large numbers for six to seven weeks during mid summer. The largest summer concentrations in the Canadian arctic occur in western Hudson Bay and in the Mackenzie Delta. Lesser concentrations occur in the high arctic on eastern Baffin Island and along the northern Quebec coast.

This study is investigating the reasons why belugas occupy their summer estuarine habitats. Cunningham Inlet, an estuary in the high arctic, has been under observation since 1981. It is the only Canadian arctic summer concentration of belugas that is not hunted. The Nastapoka River in eastern Hudson Bay is an estuarine concentration which is heavily hunted by the Inuit of northern Quebec. It has been observed for two seasons, 1983 and 1984.

2616 STEWART, D.B., and BERNIER, L.M.J. - 1983
An aquatic resource survey of Victoria and King William Islands and the northeastern District of Keewatin, Northwest Territories; *Env. Can. & Ind. & Northern Affairs Can.*, Land Use Infor. Series Background Rep. no. 3, 124 p.

This report documents the results of fisheries survey work conducted in the summer of 1982 for the Northern Land Use Information Series (NLUIS) mapping program. The survey encompassed King William Island and the southern portions of Victoria Island and Boothia Peninsula, District of Franklin, and part of the northeastern District of Keewatin, Northwest Territories. These areas border Coronation Gulf, which is part of the Northwest Passage and a potential transportation route for Arctic resources, and they include several proposed gas pipeline routes.

Fish are a vital resource for residents of communities situated in the survey area. Residents of Holman, Cambridge Bay, Gjoa Haven, Spence Bay and Pelly Bay depend on fishing for food and employment. Indeed, the largest commercial Arctic charr (*Salvelinus alpinus*) fishery in the Northwest Territories is located at Cambridge Bay.

This report provides detailed information on the biology and utilization of fish species inhabiting the study area. It supplements comments included on 1:250,000 scale maps in the Northern Land Use Information Series and is one of a series of reports detailing fisheries survey work throughout the Northwest Territories.

2617 STIRLING, I. - 1984
A group threat display given by walruses to a polar bear; *J. Mamm.*, vol. 65, no. 2, pp. 352-353.

This note describes an apparently coordinated threat display given by a group of walruses (*Odobenus rosmarus rosmarus*) to a polar bear (*Ursus maritimus*). On 4 April 1983, 30 to 35 walruses were visible in the water or hauled out on the ice at the small recurrent polynya at

Cape Collins on the northeast corner of Dundas Island in the Canadian High Arctic. Observations were made with a Bausch and Lomb 15-60x zoom Balscope from a cliff-top hut on the tip of Cape Collins, approximately 90 m above sea level. Unfortunately, a hydrophone was not in the water at the time. The main polynya was approximately one km in diameter at the time. There were several small holes in the ice, a few meters in diameter, along the eastern end of the polynya and a few larger ones up to about 200 m across near the northern side.

2618 THOMAS, D.C., and EDMONDS, J.E. - 1984
Competition between caribou and muskoxen, Melville Island, NWT, Canada; *Univ. Alaska*, Biol. Pap, Spec. Rep. no. 4, pp. 93-100.

The relative use by Peary caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibos moschatus*) of 21 sites and 9 range types on eastern Melville Island, NWT, Canada, was examined and fecal densities related to cover and biomass of plant species and groups. Caribou fecal densities were, on a relative scale, moderate to high on most of the mesic to xeric sites and low in the hydric and hydric-mesic sedge meadows. Use of the sites by caribou was significantly different from their use by muskoxen. Correlations of caribou fecal densities with cover and biomass of plant species and groups revealed disassociations with sedges and graminoids and associations approaching significance for lichens, *Salix arctica*, forbs, and *Luzula* spp. However, combinations of those plant species or groups often produced significant r values. Muskox fecal densities were strongly correlated with *Carex aquatilis* var. *stans*. Our data on relative fecal densities of the 2 ungulates indicated little overlap for space or forage.

2619 TODA, M.J. - 1984
The northernmost subarctic Drosophilidae; *Inst. Low Temp. Sci.*, Contr. no. 2357, Hokkaido Univ., Japan, pp. 193-194.

The northernmost areas of the Holarctic region are the most interesting for consideration of biogeographical relationships between the two continents, Eurasia and North America, for it is there that the two continents were sometimes connected in the past and are the closest even at the present time, through Beringia and several Arctic islands. In a recent monograph on drosophilid biogeography, Nearctic and Palaearctic drosophilids were reviewed but the northernmost fauna in the two regions was not specified.

The strong cohesion of drosophilid distribution to woodland areas has been confirmed not only latitudinally but also altitudinally except for some specimens sporadically collected far beyond the forest boundary. It can be, therefore, concluded that the northernmost drosophilid fauna as a biogeographical entity is virtually confined to the subarctic forest zone, never deeply entering the real tundra.

In 1956 Basden listed a total of 23 arctic species by choosing arbitrarily the Arctic Circle as the southern limit of the area, though this is obviously artificial and biologically meaningless as recognized by himself. Since then, considerable information on northern drosophilid fauna has been brought from several subarctic localities, Alaska, northern Finland, and Mackenzie Delta, N.W.T., Canada. By reviewing these reports, the northernmost subarctic drosophilid fauna are listed below. The chorological types are classified into four: Palaearctic (P), Nearctic (N), Holarctic (H) and Cosmopolitan (C); and are given before the specific number.

2620 TODA, M.J. - 1985
Habitat structure of a drosophilid community at Inuvik, NWT, Canada (Diptera: Drosophilidae); *The Canadian Entomologist*, vol. 117, pp. 135-137.

The northern subarctic region is the limit of the distribution of Drosophilidae; the family is of tropical origin. Hence, a drosophilid community inhabiting the northernmost subarctic region is likely to have a relatively simple community structure. This note presents information on the habitat preferences of a drosophilid community at Inuvik (68°22'N, 133°45'W) in the Mackenzie delta, Northwest Territories, Canada.

2621 URQUHART, D.R. - 1982
MUSKOX - Life History and Current Status of Muskoxen in the NWT; *N.W.T. Renewable Resources*, Wildl. Serv., Yellowknife, NWT, 40 p.

The Northwest Territories supports most of the world's muskox (*Ovibos moschatus*) population. Once a circumpolar species, the muskox is now confined to Canada, Alaska, Greenland and Norway. It has recently been reintroduced to the U.S.S.R. This large herbivore, which inhabits one of the most inclement regions of arctic Canada, remains a source of wonder and respect to those who contemplate the hardships over which it triumphs.

For centuries and possibly millenia, muskoxen and men have pursued a relationship which, in recent times at least, has proven beneficial to both. Long an almost ignored species, the muskox is at last recovering from intensive hunting in the 19th century. It may again with proper management become a principal source of food and revenue for people in the N.W.T.

2622 URQUHART, D.R., and SCHWEINSBURG, R.E. - 1984
POLAR BEAR - Life History and Known Distribution of Polar Bear in the Northwest Territories up to 1981; *N.W.T. Renewable Resources*, Wildl. Serv., Yellowknife, NWT, 70 p.

For millenia, the arctic seas have been annually congealing into a vast sheet of ice. Yet in all that time, the surface has become the home for only one creature. That the denizen of this frozen desert should be a bear is one of Nature's unfathomable pranks, for the entire family abhors winter. Thus the polar bear is a paradox: the colour a bear should not be, living where a bear should not live, doing what a bear should not do. The incongruity of this huge animal flourishing in the harsh Arctic continually fascinates all who contemplate its marvellous existence. As a symbol for the Northwest Territories - the land of ice and cold - there is no better choice than this animal which thrives by virtue of its strength, ingenuity and perseverance. In a place where magnificent wildlife species abound, the polar bear is pre-eminent - as much a lord of the Arctic as the lion is of Africa.

The many admirable, fearsome, and endearing qualities of the polar bear were well known to indigenous peoples, whose stories and myths featuring this animal are legion. From a practical standpoint, the polar bear provided some food and clothing but was not a central resource for human subsistence in pre-historic times. However, with the arrival of Europeans came the hide trade and, much later, sport hunting, so that the value of this species to arctic residents is much greater now than in the past.

Until recently, humans and polar bears pursued reciprocal lifestyles: humans killed some bears, bears killed some humans, and they both hunted for seals. Modern weaponry has tipped the balance and the polar bear escaped extinction only through worldwide efforts. Although no longer an endangered species, the polar bear's future is still precarious because of mounting industrialization in its habitat. Areas in the Arctic likely to be affected by resource development and its related activities are shown in Figure 1. If past lessons are heeded, and conservation ethics are sincerely maintained through responsible management, the status of polar bears need never be jeopardized again.

2623 WIGGINS, G.B., and WINCHESTER, N.N. - 1984
A remarkable new caddisfly genus from northwestern North America (*Trichoptera, Limnephilidae, Limnephilinae*); *Can. J. Zool.*, vol. 62, no. 9, pp. 1853-1858.

Adults of *Sphagnophylax meiops* gen. et sp. nov. are described from the Yukon and Northwest Territories of Canada. The habitat is small, low-lying tundra basins where water lies on the surface for brief periods in the spring, later receding into a saturated layer of organic debris. Affinity of *Sphagnophylax* with the four tribes of the Limnephilinae is questionable. Apomorph characters shared with the Chaetopterygini are open to conflicting interpretations, and others are discordant or unique in the Limnephilidae, indicating that *Sphagnophylax* is best assigned as Limnephilinae *incertae sedis* until more information is available.

2624 WÜRSIG, B., DORSEY, E.M., RICHARDSON, W.J., CLARK, C.W., and PAYNE, R. - 1985
Normal behavior of bowheads, 1980-84; *in* Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-84. Ed. W.J. Richardson, Unpubl. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA, pp. 13-88.

Behavior of bowheads was observed during August and early September of 1980-84, mainly during 98.5 h while an observation aircraft circled at altitude $\geq$457 m above 'presumably undisturbed' whales. In 1980, 1983 and 1984, most whales studied were in waters 10-30 m deep, although not in the same areas during various years. In 1981 they were often in water about 50 m deep, and in 1982 most were in water >100 m deep. Year to year variation in distribution and behavior may have been attributable to changes in zooplankton availability, although this is unproven.

BOTANY

2625 ADAMS, C.M., and HUTCHINSON, T.C. - 1984
A comparison of the ability of leaf surfaces of three species to neutralize acidic rain drops; *New Phytologist* vol. 97, pp. 463-478.

In order to compare the ability of leaf surfaces of different species to neutralize acidic rain, acidic droplets of identical size were placed on leaves of *Artemisia tilesii, Spinacea oleracea* and *Phaseolus vulgaris*. The pH values over time were measured using a micro-pH electrode. The pH of rain droplets initially of pH 3.0, 3.5 and 5.6 increased after contact with leaves of these species. However, for droplets of pH 2.5 the pH of droplets actually decreased with time on leaves as the drops evaporated, despite the very large quantity of hydrogen ions neutralized by the leaf surface. Neutralization of acidic droplets were greatest in *A. tilesii* plants, which also showed the lowest sensitivity to foliar injury from simulated acid rain. *Spinacea oleracea* leaves were the least able to neutralize acid droplets and also were most sensitive to foliar damage. In each species the more acidic the rain, the greater the quantity of hydrogen ions neutralized by the leaf surface. This ability to neutralize acidic droplets on the leaf surface may be an effective means of reducing damage by acid rain, especially since rain events with a pH < 3.0 are very rare. Neutralization of acidic droplets may be brought about when cations are leached from exchangeable pools or by dissolution of salts deposited on the leaf surface through guttation. Large increases in Ca especially, but also in Mg and K in droplets collected from leaves of *A. tilesii*, suggest that these cations may play an important role in increasing the pH of acidic droplets.

2626 ADDISON, P.A., and BLISS, L.C. - 1984
Adaptations of *Luzula confusa* to the Polar Semi-Desert Environment; *Arctic*, vol. 37, no. 2, pp. 121-132.

Luzula confusa is both morphologically and physiologically adapted to the polar semi-desert environment of the western Queen Elizabeth Islands. This species combines the more efficient graminoid photosynthetic system and a less drought-resistant mechanism with some of the cushion plant energy-trapping characteristics such as tufted growth form and persistence of dead leaves, with consequent thicker boundary layer. In this manner, the plant is able to assimilate carbon throughout the 24-h arctic day. The species utilizes the most favorable part of the growing season by rapid initiation of growth via relatively high photosynthetic rates, especially at low temperatures. This species is very responsive (net assimilation rates) to small changes in leaf temperature and leaf water potential. This permits the species to take advantage of small rises in leaf temperature (leaves normally 5 to 8°C) and to adjust to high VPD and low leaf water potential during the occasional drought.

The slow-growing, long-living conservative strategy of this species appears ideally suited to areas that are limited in their vascular plant cover because of rigorous environments. Within the range of habitats available, *Luzula confusa* predominates in sites of intermediate moisture with abundant cryptogams. It does not occur in the polar deserts with their drier surface soils except in snowflush communities.

2627 BLISS, L.C. - 1972
Devon Island research 1971; *in* Proc. IV Inter. Meeting on the Biological Productivity of Tundra, F.E. Wielgolaski and T. Rosswall eds. Tundra Biome Steering Committee, Stockholm, pp. 269-275.

The research continued to emphasize the physical environment and the biological response of organisms on meadows (*ca* 49% of the lowland) and raised beach ridges (*ca* 15 % of the lowland) in the Truelove Lowland. The lakes (22 %) were not included in the studies and all data are expressed on the basis of a 3300 ha land area. As in 1970, the research was concentrated on a typical mesic meadow (soils, meteorology, primary production, nitrogen fixation, invertebrates, decomposition) with additional data gathered in 2 to 5 other meadows (extensive sites), depending upon the research unit. The intensive beach ridge site, approximately 7500 years old, was studied with the same components of research as the master meadow site. In addition, 2 to 11 other beach ridges (extensive sites), and a site on the plateau (*ca* 300 m above sea level) were studied in varying detail (soils, meteorology, primary production, and invertebrates). In all, 22 separate research projects were conducted in 1971.

2628 BLISS, L.C., SVOBODA, J., and BLISS, D.I. - 1984
Polar deserts, their plant cover and plant production in the Canadian High Arctic; *Holarct. Ecol.*, vol. 7, pp. 305-324.

A total of 41 stands was sampled for species composition and 29 of these stands for plant standing crop and net annual production at 7 sites on 6 arctic islands. Fourteen additional sites on 10 islands were studied in less detail.

Through polar ordination, three groupings were recognized: polar barrens with an average species richness of 6, a phytomass of 24 g m^{-2}, and a net annual production of 0.8 g m^{-2}. Comparable data for the cushion plant and snowflush communities were 9, 120, 3 and 13 species 400 g m^{-2}, phytomass and 41 g m^{-2} net production respectively. Cryptogams are minor except within snowflush communities.

The soils show no horizon development, are alkaline, and are very low in organic matter, nitrogen, and phosphorus. It is believed that the combination of limited soil moisture in mid-summer and very low nutrient levels are the primary reason for such low plant cover and plant production in these predominantly polar barren landscapes. Geologic substrate with an abundance of frost-shattered rock and topographic position are factors that control the limited availability of water.

2629 BLISS, L.C., and SVOBODA, J. - 1984
Plant communities and plant production in the western Queen Elizabeth Islands; *Holarct. Ecol.*, vol. 7, pp. 325-344.

A study of soils, plant communities, and net annual plant production was conducted with 41 stands at 3 sites on 3 arctic islands. Twelve additional sites were studied in less detail on Ellef Ringnes, King Christian and Melville islands and on four other islands. Through polar ordination five groupings were recognized. *Alopecurus* and *Puccinellia* barrens on sand to silty soils and on silty soils, high in sodium salts respectively. Species richness averaged 2.6 ± 2.0 and total plant cover 6.8 ± 2.7%. The *Phippsia* barrens occur on sheet eroded surfaces and in gulleys with deep winter snow. Species richness was 9.8 ± 5.0 and total plant cover 14.8 ± 9.6%. The graminoid steppes on sandy soils averaged 7.6 ± 2.4 species and total plant cover 40.0 ± 2.8%. Eight stands were dominated by moss-graminoids, mostly on loam soils. Species richness was 24.9 ± 3.4 and total plant cover 77.7 ± 16.1%. Plant production was 8.0 g m^{-2} in a *Puccinellia* barren and 9.4 g m^{-2} in a *Luzula confusa* graminoid steppe. Net annual production ranged from 18.8 to 58.7 in 6 other stands. The 13 stands within the cryptogam-herb community complex occur on sandy loam to clay-loam soils. Species richness averaged 26.3 ± 6.2 and total plant cover 61.2 ± 24.7%.

Mosses and lichens play a significant role in the establishment and maintenance of communities with a greater species richness and plant production of vascular plant species. The ability of mosses to hold moisture and the presence of limited bluegreen algae that fix nitrogen appear essential to the maintenance of greater species richness, plant cover and plant production compared with the barren polar deserts that are often nearby.

2630 BOURGEOIS, J.C., KOERNER, R.M., and ALT, B.T. - 1985
Airborne pollen: a unique air mass tracer, its influx to the Canadian High Arctic; *Annals Glaciology*, vol. 7, pp. 109-116.

A study of pollen grain concentration in surface snow and ice cores at 15 sites in the Canadian high Arctic and one site near the tree line together with published pollen deposition rates south of the tree line has shown long-range dispersal of pollen from the boreal forest to the limits of our area on the Arctic Ocean close to Svalbard and the North Pole. There are no discernible trends of deposition rates within the high Arctic which suggests extremely long trajectories with strong zonal components; some of the pollen may have an Eurasian source. We relate the trajectories to synoptic patterns in the mid- and high Arctic.

2631 CODY, W.J., SCOTTER, G.W., and ZOLTAI, S.C. - 1984
Additions to the Vascular Plant Flora of the Bathurst Inlet Region, Northwest Territories; *Canadian Field-Naturalist*; vol. 98, no. 2, pp. 171-177.

Forty-two species are added to the known flora of the Bathurst Inlet region as a result of field surveys of 32 localities in 1979. Bathurst Inlet lies entirely beyond the treeline and within the Canadian Shield, with five plateau regions. Phytogeographic affinities of the known flora of about 260 species are 63% circumpolar, 13% amphi-Beringian, 3% amphi-Atlantic, 20% North American and 1% Cordilleran.

2632 CODY, W.J., SCOTTER, G.W., and ZOLTAI, S.C. - 1984
Additions to the Vascular Plant Flora of Bylot Island, Northwest Territories; *Canadian Field-Naturalist*, vol. 98, no. 4, pp. 485-488.

Twenty-six species are added to the known flora of Bylot Island as a result of field surveys of 16 localities in 1982. Mountainous terrain produces a strongly vertical zonation of the vegetation; low arctic tundra is common at lower elevations, polar semi-desert communities dominate the hills and polar desert vegetation is encountered at high elevations.

2573 DAWSON, M.R., and HICKEY, L.J. - 1984
Additional evidence on age disparity of High Arctic terrestrial biota during the Late Cretaceous and Early Tertiary; *Abstract in* Can. Paleontology and Biostratigraphy Seminar, Ottawa, Sept. 28-30, 1984

2633 EDLUND, S.A., and EGGINTON, P.A. - 1984
Morphology and description of an outlier population of tree-sized willows on western Victoria Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 84-1A, pp. 279-285.

Near the head of Minto Inlet, on western Victoria Island, discontinuous thickets of *Salix alaxensis* (feltleaf willow), ranging in age from less than 5 years to at least 81 years, reach heights of up to 8 m. They thrive in half a dozen deep valleys and sheltered ravines along the north shore of the inlet, where the microclimate is favourable. These outliers represent disjunct populations more typical of floodplains near treeline, several hundred kilometres to the south and west.

2634 EDLUND, S.A. - 1984
Tree and low, erect shrub growth forms of feltleaf willow at Minto Inlet, Victoria Island, N.W.T., Canada; *Abstract in* Proc. 13th Annual Arctic Workshop, Boulder, Colorado, March 15-17, 1984, p. 6.

Feltleaf willow, *Salix alaxensis* (Anderss.) Cov., is a thicket forming erect shrub which generally reaches heights of less than 1.5 m, and is confined to modern floodplains and persistent drainage channels on Victoria Island in the Canadian Low Arctic. Yet thickets of this species locally attain heights of 3 to 8 m along the Kuujjua River and in numerous valleys and ravines along the north shore of Minto Inlet. This size is more typical of species at or near treeline, several hundred kilometres to the south and west.

Preliminary dendrochronologies were begun at a site near the head of Minto Inlet where both tree and low shrub thickets occur on the same floodplain. No typical correlations between age and height or age and growth rate were found. Instead, increases in both height and growth rate correlated best with nearness to the deepest channels. This trend is seen in both mature tree and shrub thickets (>50 years old) and young seedlings (<10 years old).

Climatological and phenological data suggest that in the Minto Inlet area the local climate is warmer than areas to the south and east. This seems to be a recent phenomenon, for there is no buried wood indicating long occupation of this site. The current population of tree-sized willow thickets was probably established in the early part of the 20th century, probably in response to the same climatic amelioration which occurred on the mainland of northwestern Canada.

2635 EDLUND, S.A., and ALT, B.T. - 1985
Congruence of regional vegetation and summer climate patterns in the Queen Elizabeth Islands, N.W.T. Canada; *Abstract in* Tech. and the Scientist, Proc. 1985 Arctic Science Conf., 36th Alaska Science Conf., Univ. Alaska, Fairbanks, Sept. 27-29, 1985, p. 179.

The summer climate of the Queen Elizabeth Islands greatly influences the composition, density and diversity of the regional plant communities. The summer climate patterns of this region are controlled primarily by the interaction of topography with the persistent northwesterly flow of air masses from the Polar Ocean, which are characterized by new freezing summer temperatures and persistent low stratus cloud cover.

Air flow in the low-lying islands of the western and north-central Queen Elizabeth Islands is unhindered by topography, and the regional impact of radiation heating from the island land masses is minimized by ice bound inter-island channels. This allows the Polar Ocean climate to penetrate deep into the Queen Elizabeth Islands. This region has the shortest melt season and coolest summer temperatures. Vascular plants are almost entirely herbaceous, with diversity often 35 species or less. Dwarf shrubs and sedges are generally absent, except in sheltered niches. Vascular plants in this region are limited to those that have an early phenology. Most species have the ability to flower within a few weeks of snowmelt.

The mountains of Axel Heiberg and Ellesmere islands deflect and modify air from the Polar Ocean. This creates a large interior belt of warmth in the eastern Queen Elizabeth Islands that stretches from southeastern Axel Heiberg Island through to Lake Hazen, northern Ellesmere Island. This zone thaws earliest, and achieves the warmest summer temperatures in the region. Dwarf shrubs and sedges dominate the vascular plant component of the plant communities, and species diversity is also greatest (more than 125 vascular plant species). In this belt of relative warmth, species with both early and delayed flowering phenology are found.

In addition to their presence in the belt of warmth, dwarf shrub and sedge communities occur in local thermal oases. This suggests that the presence of these communities may be useful in mapping mean summer temperature distributions. In the same way, the exclusive presence of herbaceous species may be used to indicate consistently lower mean summer temperatures.

2636 EDLUND, S.A. - 1985
Lichen-free zones as neoglacial indicators on western Melville Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 85-1A, pp. 709-712.

Extensive lichen-free zones occur adjacent to several small glaciers on the plateau of western Melville Island. These zones are generally snow-free for at least a few weeks every summer. It is suggested that the zones developed during a period when perennial snow and ice covered more than six times the present area of ice, down to 400 m elevation. This probably coincided with

expansion of ice caps and snow fields during the Little Ice Age elsewhere in the Arctic.

2637 FLÜGEL, W-A., and MÄUSBACHER, R. - 1981
Observations of small organic forms at Oobloyah Valley, northern Ellesmere Island, N.W.T., Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, Heidelberger Geographische Arbeiten, vol. 69, pp. 559-563.

2638 KING, L. - 1981
The mosses of peat mounds, Oobloyah Bay, northern Ellesmere Island, N.W.T., Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, Heidelberg Geographische Arbeiten, vol. 69, pp. 555-558.

During the Heidelberg Ellesmere Island Expedition 1978 to Oobloyah Bay (81°N, 83°W), northern Ellesmere Island, N.W.T., Canada, the author mapped the distribution of peat mounds in the expedition area and tried to get information about their origin by systematic diggings. Frequent shield-shaped mounds in peat bogs, a few dome-shaped mounds in badly drained and shallow depressions and some conspicious mounds ("bird perches") at places very dry and strongly exposed to the wind were analysed. All these mounds are favoured observation points for birds and mammals, and the rich vegetation profits of manure.

2639 LICHTI-FEDEROVICH, S. - 1985
Diatom dispersal phenomena: diatoms in rime frost samples from Cape Herschel, central Ellesmere Island, Northwest Territories; *in* Current Research, Part B, Geol. Surv. Can., Paper 85-1B, pp. 391-399.

The presence of marine and freshwater diatoms in rime frost samples collected in two successive years, clearly shows the significance of atmospheric diatom dispersal. Floristic similarity between all samples, based mainly on the abundance of the principal element, *Nitzschia cylindrus* (Grunow) Hasle, overrides any spatial or temporal differences as well as dissimilarities due to variation in substrate. A positive causal relationship exists with two meteorological variables, fog and southwesterly wind.

2640 MÄUSBACHER, R. - 1981
Vascular plants of the Oobloyah Bay region, northern Ellesmere Island, N.W.T., Canada, an annotated list of the plants and phenological records; *in* Results of the Heidelberg Ellesmere Island Expedition, Heidelberg Geographische Arbeiten, vol. 69, pp. 541-553.

The list of vascular plants collected in the expedition area (Oobloyah Bay 80°50 N/83°W) during summer 1978 shows 44 species and 2 varieties. The most important findings are *Pucinellia agrostidea, Carex arctogena, Lucula spicata, Salix cordifolia* var. intonsa, *Veronica alpina, Sagina linnaei* and *Draba longipes*. For these species the expedition area is now the northern most known locality in the Canadian Arctic. The most common species are *Dryas integrifolia* and *Cassiope tetragona*.

The first flowering dates recorded on three different habitats in the base camp area demonstrates that the phenology is of restricted value for the climatic comparison of different regions in the Canadian Arctic.

2641 McANDREWS, J.H. - 1984
Pollen Analysis of the 1973 Ice Core from Devon Island Glacier, Canada; *Quaternary Res.*, vol. 22, pp. 68-76.

Meltwater from a 299-m-long ice core was filtered and analyzed for fossil pollen and spores. Pollen concentration was higher in the late Holocene and interglacial intervals (ca. 7 liter^{-1}) than in the early Holocene and Wisconsinan (ca. 1-2 liter^{-1}) ones. The late Holocene and interglacial assemblages were dominated by *Alnus* (alder), whereas the early Holocene and Wisconsinan ones were dominated by *Betula* (birch) and *Artemisia* (sage). During the Holocene and probably the last interglaciation, most of the pollen and spores were blown a minimum of 1000 km from low arctic shrub tundra and adjacent subarctic *Picea* (spruce) forest; these areas were dominated by the arctic air mass during the summer pollinating season. During the Wisconsinan - early Holocene, glacier ice and arctic air were more widespread and pollen sources were more distant; thus, at this time relatively little pollen was incorporated into the ice.

The Devon ice-core data suggest that there should have been pollen in the continental ice sheet of Wisconsin time. When the ice sheet retreated this pollen would be carried by meltwater and redeposited with silt and clay together with contemporary pollen, producing an ecologically anomalous assemblage.

2642 MILLER, N.G., and ALPERT, P. - 1984
Plant associations and edaphic features of a High Arctic mesotopographic setting; *Arctic & Alpine Res.*, vol. 16, no. 1, pp. 11-24.

Cover of blue-green algae, bryophytes, and vascular plants, and number of bryophyte species, increased along a topographic gradient from the crest of a beach ridge down into a tundra meadow on Bathurst Island, Arctic Canada; lichen cover was greatest in the middle of the slope. Soil moisture, organic content, and nutrient concentrations increased along the same gradient and pH became slightly less alkaline. Crest and slope plant associations varied between nearby sites and differed considerably from the more constant tundra meadow association, which resembled *Drepanocladus brevifolius* community recognized elsewhere in the High Arctic. Among edaphic characteristics, soil moisture was most closely correlated with vegetation.

2643 PEACH, J. - 1983
Donation not Mutation; *in* Quarterly Bull. Alpine Garden Society, ed. R.C. Elliott, vol. 51, no. 2, no. 212, pp. 119-128.

Mutation is defined in the Penguin Dictionary of Biology as a sudden change in chromosomal DNA. In common with many, perhaps most known definitions of the phenomenon, it fails to suggest what causes the sudden change. The writer rejects this nebulous approach, and where plants are concerned, suggests that the donation of genetic elements is possibly a more accurate description of the general cause of variation. His evidence for this is derived from his study of the geographical differentiation of the circumpolar species, *Saxifraga oppositifolia*.

2644 SOHLBERG, E.H., and BLISS, L.C. - 1984
Microscale pattern of vascular plant distribution in two high Arctic plant communities; *Can. J. Bot.*, vol. 62, no. 10, pp. 2033-2042.

Microscale pattern is of crucial importance in determining the distribution of vascular plants in the extreme environments of the High Arctic. Point-quadrat analysis of the distribution of the vascular plants in a mesic cryptogam - herb meadow and a xeric *Puccinellia* barren found a nonrandom distribution of vascular species. Most species were found growing in moss turfs versus crustose lichen or bare soil surfaces in the meadow and in desiccation cracks in the barren. Two species showed an opposite distribution pattern in the meadow indicating that incipient niche differentiation occurs in the High Arctic. Quadrat sampling showed that seed distribution was random in the meadow and only slightly skewed toward cracks in the barren. Microsites appeared to be crucial to the seedling establishment and adult distribution pattern for *Papaver radicatum* but less important for *Ranunculus sabinei*. Microclimate analyses showed that soil temperatures were higher, wind speeds were lower, soil moisture content was greater, and nitrate levels were higher in the microsites usually preferred by plants.

2645 THOMSON, J.W., and SCOTTER, G.W. - 1984
Lichens of Bylot and Northern Baffin Islands, Northwest Territories, Canada; *The Bryologist*, vol. 87, no. 3, pp. 228-232.

One hundred and sixty-five species of lichens are reported from Bylot Island and 145 species from northern Baffin Island, together with earlier reports making a total of 337 species from this part of the Arctic. One new combination, *Aspicilia composita* (Lynge) Thoms. is made. New to Canada are *Buellia pulverulenta, Catillaria groenlandica, Lecania arctica, Lecanora microfusca,* and *Lecanora torrida.*

2646 THOMSON, J.W., and SCOTTER, G.W. - 1985
Lichens of Eastern Axel Heiberg Island and the Fosheim Peninsula, Ellesmere Island, Northwest Territories; *Canadian Field-Naturalist*, vol. 99, no. 2, pp. 179-187.

One hundred and seventy-nine lichen taxa are listed from these high arctic islands: 149 from Axel Heiberg Island, 129 of them not previously listed. New to Canada are *Acarospora cartilaginea, Aspicilia cingulata, A. contigua, A. humboldtii, Buellia nivalis, Caloplaca alcarum, Lecidea sublimosa,* and *L. tenuissima.* New combinations are: *Aspicilia contigua* (Lynge) Thoms., *Aspicilia humboldtii* (Lynge) Thoms., and *Aspicilia nathorstii* (Lynge) Thoms. Three lichen parasites, *Discothecium gemmiferum, Rhabdospora lecanorae,* and *Tichothecium pygmaeum,* are also listed.

2647 TODA, M.J., and TANNO, K. - 1983
The convergence of habitat structure in tundra collembolan communities (Insecta: order collembola); *Can. Ent.*, vol. 115, pp. 1129-1145.

Habitat structure of two collembolan communities, one at Barrow, Alaska, U.S.A., and the other at Tuktoyaktuk in the Mackenzie Delta, Canada, has been analyzed in relation to microtopographies characteristic of tundra regions. Multivariate statistical techniques, cluster analyses (UPGMA), and principal component analyses (PCA) reveal various ecological changes in component species. In spite of such local variations in component species, the two communities show similar patterns of habitat structure that are organized principally along a gradient of environmental moisture.

CESAR

2648 AKSU, A.E., and MUDIE, P.J. - 1985
Magnetostratigraphy and palynology demonstrate at least 4 million years of Arctic Ocean sedimentation; *Nature*, vol. 318, no. 6043, pp. 280-283. *CESAR Contr. No. 5.*

It has long been recognized that the Arctic Ocean has a major role in regulating the timing of Northern Hemisphere glaciations, global heat exchange and ocean circulation. Several recent studies have attempted to interpret the palaeoclimatic record in sediment cores from the Arctic Ocean, but conflicting ages have been reported for palaeoclimatic events dated by different methods. To establish a consistent chronology for cores from the central Arctic Ocean, we performed detailed palaeomagnetic and palynological studies of three cores collected near the crest of the Alpha Ridge, and obtained radiocarbon dates from planktonic foraminifers isolated from 1-cm-thick intervals. Magnetic inclination values for these cores clearly record normal and reversed-polarity intervals that apparently correspond to the Brunhes and Matuyama magnetochrons; the longest core also includes polarity intervals typical of the Gauss and Gilbert magnetochrons. This chronology is confirmed by the first and last occurrences of pollen and dinoflagellate species that can be correlated with European and DSDP chronostratigraphies dated by standard biochronological methods. Micromass radiocarbon dates for foraminifers indicate a sedimentation rate of ~1 mm per 1,000 yr. We believe that these data confirm a long (>4 Myr) chronology for the Alpha Ridge cores, the lithostratigraphy of which can be correlated over extensive areas of the western Arctic Ocean, and more important, provide dinoflagellate and palynomorph data that indicate the validity of early chronology.

2649 AKSU, A.E. - 1985
Paleomagnetic stratigraphy of the CESAR cores; *Geol. Surv. Can.*, Paper 84-22, pp. 101-114. *CESAR Contr. No. 14.*

Three cores of Cenozoic-Recent sediment from the Alpha Ridge cordillera of the Arctic Ocean have been studied paleomagnetically. Plots of stable inclinations versus depth in the cores show the presence of distinctive normal and reverse polarity chrons resembling those observed elsewhere, and correlation with the accepted paleomagnetic stratigraphy is attempted. An average sedimen-

tation rate of 1.00 mm/1000 years is calculated, based on the Brunhes-Matuyama and Matuyama-Gauss transitions. The oldest sediments represented in these cores were deposited between 4.5 and 4.2 Ma BP.

Four major lithostratigraphic units are present in CESAR core 83-6. Paleomagnetic study of the Cretaceous-Paleocene pelagic siliceous section of unit 4 yielded a sequence of magnetic polarity zones that may be correlated with the marine magnetic anomaly profiles. This unit is characterized by two reversed chrons (A- and C-) and a shorter positive chron (B+).B+ may be correlated with anomaly 29 or 30 plus 31. In both cases, the magnetic data disagree with the Campanian age assigned by diatom data, and partially agree with the Maastrichtian age suggested by silicoflagellate data. Correlation of the magnetic data from units 1,2 and 3 is uncertain because these sediments are devoid of diagnostic microfossils. However, the short reversed polarity zone at the upper part of the core suggests a minimum age of 0.73 Ma (older than Brunhes normal polarity chron) for the core top.

2650 AKSU, A.E. - 1985
Planktonic foraminiferal and oxygen isotopic stratigraphy of CESAR cores 102 and 103: preliminary results; *Geol. Surv. Can.*, Paper 84-22, pp. 115-124. *CESAR Contr. No. 16.*

Two gravity cores from the eastern Alpha Ridge, Arctic Ocean, include a continuous sedimentary record of the last 1 Ma. In most sample intervals, planktonic foraminifera are the dominant component of the biogenic skeletal debris in the >63μm sediment fraction, with pteropods, benthic foraminifera, ostracods and pelecypods not exceeding 2%. *Neogloboquadrina pachyderma* (left and right coiled) and *Neogloboquadrina cryophila* are the major planktonic foraminifera; *Neogloboquadrina pulusi, Globigerina quinqueloba, Globigerina egelida* and *Globigerina bulloides* are secondary in abundance. Oxygen isotopic composition of *Neogloboquadrina pachyderma* together with the foraminiferal data suggest the following paleoenvironmental conditions.

Large scale decreases in planktonic foraminiferal abundances reflect: i) dilution of the surface waters by increased runoff, during marine isotopic stage 3 and for part of lithofacies L; ii) increased calcium carbonate dissolution on the seafloor, as indicated by very low total foraminiferal counts near the base of core 83-103; and iii) intervals of thicker sea ice, which would decrease primary productivity. Sediment intervals with high abundances of foraminifera strongly suggest relatively high productivity in the water column, but there is no evidence in the faunal or isotopic record of the gravity cores to suggest pack-ice free conditions during the past 1 Ma.

2651 AMOS, C.L. - 1985
Bottom photography and sediment analyses on CESAR; *Geol. Surv. Can.*, Paper 84-22, pp. 25-45. *CESAR Contr. No. 11.*

An evaluation is made of the sediment transport pathways which lead to the accumulation of the bottom material in the vicinity of the Alpha Ridge. An estimate is also given of the sources of the material, the factors controlling deposition and, where appropriate, on the accumulation rates. Biogenic material, ice-rafted debris and weathered bedrock by-products make up the majority of the seabed sediment. The relative abundance of each component varies from the Alpha Ridge crest to the trough. Minor amounts of eolian-derived debris were detected in the pack ice and yet lower amounts of inorganic debris were measured in the water column.

Ice-rafted pebbles and cobbles were generally rounded and calcerous. Which suggests a source from a coastal region on the adjacent Canadian landmass.

The recovery of bedrock in the dredging program verifies the occurrence of outcrops on the south flank of the northern Alpha Ridge crest. The samples recovered are (1) well weathered basalts which have an elemental composition similar to floes sampled in the ice pack and water column, and (2) from fine grained sediment samples recovered from adjacent basins. A local bedrock source of bottom sediments had not hitherto been considered significant.

2652 ASUDEH, I., GREEN, A.G., and FORSYTH, D.A. - 1985
The Uniform Waveforms of Arctic Crustal Data from CESAR 1983: An Extensive Study of Multiple Reflections and P-to-S Converted Phases; *Abstract in Geophysics*, vol. 50, no. 8, p. 1362-1363. Presented at CSEG/CGU Convention.

Most of the 700 km reversed refraction data collected during the CESAR 1983 survey across the northern Alpha cordillera and the adjoining Makarov basin show the following features: (a) the P waveform is uniform and undisturbed for distances up to 100 km, and there is no evidence of a significant reflector in the upper crust. (b) Multiple reflections and P to S to P conversions from the water and sedimentary layers can be identified on most of the sections, providing useful constraints on the water and sedimentary thickness. Extensive analysis of first arrivals and multiply reflected and converted phases, using both 1-D and 2-D synthetic seismogram routines, indicate an oceanic plateau type structure for the Alpha cordillera, with the P-wave velocity uniformly increasing to about 7.6 km/s at 16 km depth and a Moho depth of about 40 km. The Makarov basin crustal structure appears to be oceanic in nature with a Moho depth of about 23 km.

2653 BARRON, J.A. - 1985
Diatom biostratigraphy of the CESAR 6 core, Alpha Ridge; *Geol. Surv. Can.*, Paper 84-22, pp. 137-148. *CESAR Contr. No. 17.*

The *CESAR 6* core, from the flank of the Alpha Ridge in the Arctic Ocean, contains a diverse, well-preserved diatom assemblage of probable Late Campanian (Late Cretaceous) age. Thirty-three diatom taxa were recorded in 10 samples from a 165 cm thick section of the core. The diatom assemblage resembles closely Late Campanian diatom assemblages from the northern Ural Mountains in western Siberia and differs markedly from known Maastrichtian diatom assemblages. The abundance of diatom resting spores and lack of shallow water diatoms suggest that deposition occurred near a shelf or bank edge which was distant from the shoreline.

2654 BUKRY, D. - 1985
Correlation of Late Cretaceous Arctic silicoflagellates from Alpha Ridge; *Geol. Surv. Can.*, Paper 84-22, pp. 125-135. *CESAR Contr. No. 16.*

Late Cretaceous silicoflagellates are abundant and well preserved in core *CESAR 6* from the Arctic Ocean. A probable Middle or Late Maastrichtian age is suggested for the core because the most widespread, long-ranged, and abundant Cretaceous silicoflagellate (*Lyramula furcula*), which is known from the Santonian-Campanian to the Late Maastrichtian, disappeared in both cores *CESAR 6* and Fl-437 on the Alpha Ridge. Partial isolation of the Arctic basin in the Maastrichtian because of shoaling or tectonic uplift of previous seaway connections could have contributed to the disappearance of *Lyramula furcula*. Comparisons with other Cretaceous silicoflagellate localities show the unique character of the Alpha Ridge assemblages with abundant *Vallacerta siderea*, sparse to common *Lyramula burchardae* and *Lyramula deflandrei*, sparse *Lyramula porta*, but no *Corbisema*, *Cornua trifurcata*, or *Vallacerta tumidula* which characterize Campanian and Maastrichtian elsewhere. The provincial character of the assemblages on Alpha Ridge probably is the result of ecologic factors such as differences in high-latitude sunlight, nutrient circulation, and possibly salinity.

2655 FORSYTH, D.A., and WEBER, J.R. - 1985
Crustal structure of the central Arctic Ocean Basin: Seismic and gravity interpretation of the Lomonosov and Alpha ridges; *Abstract in* Inter. Workshop on Density Distribution of the Lithosphere, Inst. Geodesy & Photogrammetry, ETH, Zurich, Rep. No. 102, p. 19.

During the LOREX 79 operation across the Lomonosov Ridge and the CESAR 84 operation on the Alpha Ridge some 2000 depth soundings and gravity observations and some 1'200 km of reserved refraction profiles were collected. The relatively simple crustal structure of the Lomonosov Ridge with a Moho depth of 28 km and vertical velocity profiles similar to those obtained on the Kara continental Shelf strongly supports the hypothesis that it is a continental sliver broken off the Kara and Barents shelves some 53 m.y. ago.

The structure of the broader Alpha Ridge is much more complex. Detailed travel-time and wave form analysis were carried out along the strike of the central part of the Alpha Ridge complex (A) and the region to the north adjoining the Makarov Basin (B). Region A and B have depths to Moho of 38 km and 23 km, respectively, and both regions indicate a P-wave velocity of 7.3 km for the lower crust. A density transect model from the Fram Basin across the Lomonosov Ridge, Makarov Basin and Alpha Ridge into the Canada Basin indicates the best fit between seismic and gravity data is obtained using a density contrast of 0.4 g/cm^3 for deep structures of continental depth and 0.25 g/cm^3 for thinner, oceanic-type crust. The gravity field across the Alpha Ridge can be almost completely explained in terms of known bathymetry and variations in Moho depth. Velocity depth structures fit neither classic oceanic nor continental crust but rather indicate the Alpha cordillera may be similar to submerged plateaus found in other ocean areas.

2656 FORSYTH, D.A., and JACKSON, R. - 1984
Alpha and Lomonosov Ridge crustal structures; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 86.

Reversed crustal refraction profiles recorded along and across the Lomonosov Ridge (LOREX) in 1979 and the Alpha Ridge (CESAR) in 1983 indicate: a) The Lomonosov Ridge has a crustal thickness of about 28 km which thins to the north and south beneath the Fram and Makarov Basins. LOREX results show 5 km of 4.7 km s^{-1} upper crustal material overlying 15-20 km of 6.6 km s^{-1} material. The suggested upper mantle velocity is 8.3 km s^{-1}. b) Crossover distances to upper mantle velocities of close to 200 km indicate the Alpha Ridge has a crustal thickness near 35 km and is clearly not typical oceanic crust. The velocity structure, however, does have some oceanic similarities - clarification requires analysis of the shallower structure. c) The crustal structure of the Alpha Ridge is significantly different from the structure of the Lomonosov Ridge near the Pole. Evolutionary schemes that suggested the two features should be similar are therefore in need of modification. d) The Alpha Ridge is much broader than perhaps has been realized. A corollary to this is that the Makarov Basin, if indeed there exists a basin with typical oceanic crust between the Alpha and Lomonosov Ridges, must be a rather narrow feature quite near the Lomonosov Ridge.

2657 JACKSON, R., and MUDIE, P. - 1984
CESAR cores: geological time capsules; *GEOS*, EM&R, vol. 13, no. 2, pp. 15-18. *CESAR Contr. No. 1.*

We can now say that most CESAR cores record a three-million-year history of sea ice growth in the Arctic Ocean. And one core contains a perfectly preserved record of plankton from a warm Cretaceous sea.

2658 JACKSON, H.R., FORSYTH, D.A., MUDIE, P., and AMOS, C. - 1984
Constraints on the tectonic origin of the Alpha Ridge; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, pp. 87-88.

The results from the CESAR programs of geologic sampling, seismic reflection and seismic refraction are combined to interpret the tectonic history of the Alpha Ridge. The age of the Alpha Ridge is limited by fossils that indicate a minimum age of about 70 million years. An estimate of basement age is made using sediment thickness, rates and velocities. This estimate is found to be compatible with constraints on age suggested by the magnetic characteristic of the Alpha Ridge of about 100 million years. The basement of the ridge is inferred to be basaltic based on such data as dredged samples, the high intensity magnetic anomalies of up to 1500 nt, and the velocities typical of basaltic crust measured on the refraction lines. The reflection profile shows the basement is rough and irregular. Faults are obvious in many areas, particularly in cross-strike profiles. A major valley, a graben-type structure, is clearly identified. The refraction data indicate there is homogeneity of crustal structure along strike, which is supported by the magnetotelluric data. The Alpha Ridge has a deep crustal root of nearly 38 km. The crustal structure is compared and contrasted to the structure of the Lomo-

nosov Ridge, the Canadian Arctic Islands and various oceanic plateaus such as Iceland. Based on crustal structure, probable age and geologic controls from the Arctic Islands, the tectonic evolution of the Alpha Ridge is described.

2659 JACKSON, H.R. - 1985
Seismic reflection results from CESAR; *Geol. Surv. Can.* Paper 84-22, pp. 19-23. *CESAR Contr. No. 10.*

The seismic reflection information collected on *CESAR* is presented to provide a continuous record of sedimentary horizons and basement relief. The sedimentary reflectors on the highs are flat lying and layered while those in the topographic lows are less regular and probably slumped. Faults predate and postdate the sediment. The age of the Alpha Ridge is estimated from its magnetic character and fossil information. The ridge's topography, sedimentary and basement structures and bedrock samples resemble those of an oceanic plateau.

2660 JODREY, F., and HEFFLER, D. - 1985
Piston coring on CESAR; *Geol. Surv. Can.*, Paper 84-22, pp. 175-177. *CESAR Contr. No. 19.*

Coring on *CESAR* presented many problems because of inexperience in attempting 10m cores from an ice platform and because the heavy equipment had to be assembled in -45°C weather. The components used, how they were put together, and a step by step procedure for taking a core is described.

2661 JONES, E.P., and ANDERSON, L. - 1984
The origin of the nutrient maximum in the Arctic Ocean; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 102.

Early studies from the T-3 Ice Island revealed maximum concentrations in phosphate, nitrate and silicate at a depth near 160 m. This feature was attributed to Bering Sea water having entered the Arctic Ocean through Bering Strait. More recently, measurements at the LOREX ice camp showed a silicate maximum at a slightly shallower depth, near 120 m. No new interpretation of this maximum was offered, though it was suggested that the nutrient maximum could involve other considerations other than simply that it was part of the Bering Sea water. We report results from the CESAR ice camp that show maximum concentrations for phosphate, nitrate and silicate also at 120 m. Measurements of alkalinity and total inorganic carbon at CESAR indicate that the nutrient maxima are a result of chemical processes occurring on the shelf regions of the Arctic Ocean and are not directly related to inflowing Bering Sea water.

2662 JUDGE, A., ALLEN, V., and TAYLOR, A. - 1984
Geothermal measurements on the Alpha Ridge during *CESAR*; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, pp. 84-85.

Ten heat flow stations were occupied on the Alpha Ridge during the CESAR project. A 3-m oceanographic probe recorded precise sediment temperatures at 7 thermistor positions along its length, and enabled the calculation of an *in situ* thermal conductivity through the analysis of a short heat pulse generated along the length of the probe. In addition, measurements of physical properties were made on core retrieved in the Marine Geology program. About 750 individual thermal conductivity measurements were made at 10-cm intervals on these cores. Approximate values of the DC electrical resistivity and the volumetric water content were obtained for 14 cores using the Time Domain Reflectometry method.

Thermal conductivities are higher in the upper metre of each core, decreasing somewhat deeper in the sediments, and are in qualitative agreement with core descriptions from the geology program. Ninety per cent of the conductivities lie between 1.2 and 1.8 W mK^{-1}; these values are half again or more higher than those typical of deep ocean sediments. Only core CR-06 in the lower few metres had conductivities of 0.8 W mK^{-1}, which are more typical deep ocean values.

Volumetric water contents are generally around 50%, somewhat less than that typical of deep ocean sediments. Both results are consistent with the hard, compacted sediments found on the Alpha Ridge.

Using these thermal conductivity determinations and the temperature gradient, estimates of the terrestrial heat flow have been calculated. These measured heat flows are low to moderate in value. At most stations, however, the heat flow varies measurably with depth in the 3-m sediment section; this variation may arise from several effects but is consistent with a change in bottom water temperature by several tenths of a degree during the preceding few months. If the measured heat flow is corrected for this transient effect, a more constant and generally lower heat flow is obtained.

The CESAR heat flow values are comparable to the values obtained more than a decade ago on the Alpha Ridge from Ice Island T-3. The low-to-moderate heat flow values determined during CESAR suggest several plausible origins for the Alpha Ridge. Such values would be typical of a fragment of continental crust or of an island arc remnant sufficiently old that any thermal signature has dissipated. Options such as a major volcanic or a spreading centre may be discarded because of the lack of evidence of enhanced heat flows during CESAR or the T-3 transects across the Ridge.

2663 MAASS, O. - 1984
Lithostratigraphy and Clay Mineralogy of the CESAR cores, Central Arctic Ocean; unpub. B.Sc. thesis, Queen's Univ., 57 p. *CESAR Contr. No. 22.*

A lithostratigraphy for the Canadian Expedition to Study the Alpha Ridge (CESAR) cores is established and compared to a similar stratigraphy for Late Miocene to Holocene sediment on the Chukchi Rise and the western and central portions of the Alpha Ridge, and a stratigraphy from the eastern flank of the Alpha Ridge, south of the CESAR cores. Sediment in the cores can be classified as either silty or arenaceous lutite, based on the relative abundance of the coarse (sand) fraction. Confident regional correlation remains possible because of several distinct units that are common to all cores. Primary sedimentary structures are absent from the CESAR cores, but burrows are common in the silty clays, and glacial erratics occur in all units.

Semi-quantitative clay-fraction mineralogy of 2 cores suggests that the minerals are inherited with little or no modification from the nearby continents. Illite, chlorite, kaolinite, smectite, calcite, dolomite, quartz, plagioclase and K-feldspar were identified. Apparently, there are two groups of mineralogies, one associated with both silty and sandy clays, and one with arenaceous clays only. Both the vertical distribution of these minerals in the cores, and the distribution of arenaceous and silty lutites is best explained by varying proportions of sea ice-rafting and glacial ice-rafting. These processes have been active at least since the Miocene. Nepheloid layer transport of silts and clays may also contribute to sedimentation on the Alpha Ridge.

Siliceous sediment of core #6 is indicative of highly productive waters during the Late Cretaceous. Strong, warm-water currents best explain the presence of these highly productive waters, and may account for the origin of the sediment waves reported by Hall (1979).

2664 MUDIE, P.J., and AKSU, A.E. - 1984
CESAR cores: Lithostratigraphic correlation and paleoenvironmental interpretation of Alpha Ridge Cretaceous and Late Cenozoic sediments; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 84.

During CESAR, sixteen Benthos piston cores and twelve gravity cores recovered up to 6 m of sediment from the southeastern Alpha Ridge. The cores provide the first information on the lithology and age of sediments covering the northern Alpha Ridge crest and adjacent graben. Initial lithostratigraphic, biostratigraphic and magnetostratigraphic studies show a correlatable sequence of litho-facies that range in age from Late Cretaceous to Recent. The graben and basins on the flanks of the Northern Ridge are filled with about 250 m of unconsolidated sediment of which the top 6 m is a continuous section of Lower Pliocene (ca 5 Ma) to Recent mud. Most facies of this mud can be correlated with USGS cores from the Southern Ridge, western Alpha Ridge and Chukchi Rise. The surficial mud consists of alternating siliclastic and carbonate-rich sediments that represent glacio-marine deposits (debris from icebergs, sea ice and rivers flowing over ice) and hemipelagic material. Cretaceous biosiliceous sediment of Late Campanian to Maastrichtian age was sampled on the edge of a fault block on the north side of the Alpha Ridge graben. The siliceous sediment contains a complex sequence of laminated diatom ooze that was probably deposited in a shallow marine environment isolated from continental terrigenous sources. Ferromanganese micronodules and low organic content suggest that the sedimentary environment was strongly oxidizing. Thin mud stringers with a high aluminum content may indicate local volcanic activity but there is no evidence of diagenetic alteration of the biogenic Opal-A, which would indicate high temperatures or deep burial. The biosiliceous sediment is overlain by unfossiliferous sand and clay that may be a volcanic ash deposit. There appears to be a major lithostratigraphic unconformity between this sediment and a thin surface layer of Late Tertiary mud.

2665 MUDIE, P.J., and JACKSON, H.R. - 1985
Summary; *in* Initial Geological Report on CESAR - the Canadian Expedition to Study the Alpha Ridge, Arctic Ocean, ed. H.R. Jackson, P.J. Mudie and S.M. Blasco; Geol. Surv. Can., Paper 84-22, pp. 3-10. *CESAR Contr. Nos. 8 - 19.*

The geological origin and age of the Alpha Ridge and its sedimentary cover have long been the subject of controversy regarding the tectonic evolution of the Arctic Ocean and its paleoenvironmental history. This volume describes sediment cores, bedrock samples and related geological and geophysical data obtained during CESAR, the Canadian Expedition to Study the Alpha Ridge. The geological aims of CESAR were to collect data which would elucidate the following scientific problems. 1) The tectonic origin and age of the Alpha Ridge. 2) The lithostratigraphy and depositional history of the overlying sediments. 3) The paleoceanographic and paleoclimatic evolution of the Arctic Ocean.

2666 MUDIE, P.J., and BLASCO, S.M. - 1985
Lithostratigraphy of the CESAR cores; *Geol. Surv. Can.*, Paper 84-22, pp. 59-99. *CESAR Contr. No. 13.*

Sixteen piston cores and twelve gravity cores were successfully recovered from northern and southern crests of the eastern Alpha Ridge and from the Alpha Ridge graben. All but one core contain late Cenozoic muds with variable amounts of sand- to pebble-sized clastic material that probably reflects transport by ice during the past 4-5 Ma. Sixteen Cenozoic-Holocene lithostratigraphic units have been delimited on the basis of sediment texture, structure, colour, detrital carbonate and authigenic ferromanganese content. The composition of the upper 13 units in the CESAR cores is similar to the Fletcher's Ice Island cores; hence most units can be broadly correlated over most of the Central Arctic Ocean. Three new lithostratigraphic units (A1-A3) occur at the base of CESAR cores from the northern Alpha Ridge crest. Paleomagnetic and palynological data indicate a Late Miocene-Early Pliocene age for unit A3, which confirms previous reports of a slow sedimentation rate during the Cenozoic.

CESAR core 6 was obtained from an erosional surface on top of a fault block at the north edge of the Alpha Ridge graben. This core contains ca. 2m of laminated diatom ooze of Campanian-Maastrichtian age and two ?Paleogene volcanic ash units below a brown mud unit which probably corresponds to units A2 and A3. The biosiliceous ooze contains no foraminifera or silicoflagellates and only few dinoflagellates. There is little difference in biogenic or clastic sediment content between light and dark laminae and the rhythmites do not appear to be annual varves produced in an upwelling environment. The microstructure and fluctuating mineral composition of the laminae most closely resemble those of laminated chart beds in the Triassic forearc basins of Japan.

2667 MUDIE, P.J. - 1985
Palynology of the CESAR cores, Alpha Ridge; *Geol. Surv. Can.*, Paper 84-22, pp. 149-174. *CESAR Contr. No. 18.*

Biostratigraphic and paleoecological studies were made of pollen, spores, dinoflagellates, algal spores and

palynodebris types in CESAR cores 103, 14 and 6 from the Alpha Ridge, central Arctic Ocean. Palynomorph concentrations are low in all these deep-sea cores, but the stratigraphic ranges of selected taxa can be correlated with established age ranges of North American and European circumpolar pollen genera and with dinoflagellate ranges documented for deep-sea cores in the Bering and Norwegian seas. These palynological data confirm the Pliocene-Recent age assigned to CESAR 103 and 14 by paleomagnetic data and the late Campanian-Paleogene age assigned to the siliceous ooze in *CESAR 6*, based on silicoflagellate and paleomagnetic data. In the late Cenozoic core, CESAR 103, fluctuations in ratios of arctic- to temperate-climate palynomorphs broadly correspond to global variations in ^{18}O values reflecting ice volume changes during the past 1 Ma. Changes in concentrations of phytoliths, algal spores, and reworked Paleozoic or Mesozoic palynomorphs suggest that the predominantly arenaceous lithofacies I and L reflect intervals of increased eolian and fluvial terrigenous sediment influx, while the carbonate lithofacies in units J, K and M reflect increased iceberg debris transport. In *CESAR 6*, very low dinoflagellate concentrations in the Cretaceous-Tertiary siliceous sediments suggest low oceanic productivity; low pollen concentrations also suggest that aerial and fluvial transport of sediment from the circumpolar continental region was minimal during this period.

2668 NIBLETT, E.R., MICHAUD, C., and KURTZ, R.D. - 1984
Magnetotelluric measurements over the Alpha Ridge; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 86.

A magnetotelluric (MT) recording station was established near the CESAR base camp early in April 1983. Three-component magnetic variations were measured with a standard fluxgate digital recording magnetometer mounted on the sea ice and programmed to sample the field at 1-min intervals. Horizontal telluric variations were derived from a north-south, east-west array of silver/silver chloride electrodes suspended in the sea water through holes in the ice. Data were acquired in the period range from 120 s to DC for all five components; in addition a band-passed telluric output was recorded separately for the range 120 - 30,000 s (8.3 h). The band-pass filters were included to reduce the possibility of contaminating the data with spurious potentials generated by ocean tides or ice drift velocities.

Good quality low-pass data were obtained for only 18 consecutive days because one of the telluric channels was adversely affected by low ambient temperatures during the early part of the experiment. However, the band-pass system yielded 30 days of high quality data. The geomagnetic transfer functions are very small and do not reveal any prominent contrasts in the electrical structure of the ocean crust. The apparent resistivity data are anisotropic at the longest periods, an effect that may be attributable to tidal influences. A preliminary interpretation indicates the presence of a highly conducting zone at a depth of about 90 km beneath the Alpha Ridge, which could be associated with partial melt in the asthenosphere.

2669 NOBLE, D. - 1983
Floating Runway - Courtesy Airborne Sappers; *Sentinel*, Can. Forces Base, Dept. National Defence, vol. 3, pp. 11-13.

After months of planning, Operation CESAR, (the Canadian Expedition to Study the Alpha Ridge) culminated with five *Hercules* transports dropping 60,000 kg of cargo and 17 paratroops in mid-March. Later, the first of 31 *Hercules* chalks landed on the ice airstrip.

A large part of DND's involvement in OP CESAR was getting 40 scientists to the camp. But the biggest task was constructing the runway needed for the *Hercules* airlift.

2670 OSTLUND, H.G., and LEE, V. - 1984
Radiocarbon and water isotopes at CESAR; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 103.

At the CESAR station, samples were collected for radiocarbon, tritium, helium-3, and oxygen-18. At time of writing, the measurements are still in process. Early results indicate that some bomb-produced C-14 has penetrated into the waters well below the halocline and temperature maximum. Tritium and O-18 seem to strongly suggest the presence of brine, presumably produced by freezing on the shelves. The data and some conclusions will be presented.

2671 OVERTON, A. - 1984
Seismic reflection profiles across the Lomonosov Ridge and on the Alpha Ridge, Arctic Ocean Basin; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, pp. 85-86.

Seismic reflection profiles from LOREX (1979) and CESAR (1983) show distinctly different sedimentation patterns associated with, and structural patterns of, the Lomonosov and Alpha Ridges. The Lomonosov Ridge is shown to be an asymmetric, block faulted structure rising 2700 m above flat lying sediments at depths exceeding 4000 m in adjacent basins near the north geographic pole. The ridge surface has an irregular morphology having slopes exceeding 7^{0} on the Amerasian slope and less than 7^{0} on the Eurasian slope. Lithologic stratification on the tops of fault blocks is evident, but somewhat obscured by strong, scattered reflections from the rough ridge surface. Seismic events from within the ridge core suggest that the ridge is underthrust by the crust of the Eurasian Basin. Sediments on the Amerasian side of the ridge form a graben approximately 2 km thick with well-defined stratifications thickening toward the centre of the graben. A pronounced reflection from a synclinal structure about 1 km below the seafloor suggests a marked change in depositional environment. The sediments of the graben abut unconformably against the Lomonosov Ridge and another ridge buried by, and barely penetrating seafloor sediments on the southside of the graben. This buried ridge may be part of the Marvin Seamounts seen on bathymetric charts, and may represent the northern boundary of the Alpha Ridge. Sediments on the Eurasian side of, and abutting unconformably against, the Lomonosov Ridge show even more pronounced stratification with total thicknesses exceeding 2 km. An unconformity separates an upper flat lying sequence of about

1 km thickness from a lower, homoclinal sequence that thickens in excess of 1 km away from the ridge. In contrast the Alpha Ridge seismic reflection profiles show no definite separation of distinct structures. The drift paths of the CESAR camps traversed small segments near the crestal region of the much larger areal extent of the Alpha Ridge. Seismic reflection profiles suggest a complex pattern of ridges and valleys. Stratified sediments in the valleys are generally less than 1 km thick. Stratification is not seen in the ridges. Basement features beneath the sediments are poorly defined on the seismic profiles.

2672 QUEK, S.H., and WELLS, D.E. - 1985
Evaluation of CMA771 Omega Receiver Performance on Project CESAR; *Univ. New Brunswick*, Dept. Surveying Engineering, Tech. Rep. no. 112, 138 p. *CESAR Contr. No. R3.*

The Canadian Expedition to Study the Alpha Ridge (CESAR) took place between March and May of 1983 in the vicinity of latitude 86°N 110°W. Amongst the various navigation aids used was a Canadian Marconi CMA771 Omega Navigation System (ONS). Geodetic positions were displayed on the control display unit (CDU) and stored on cassette tapes.

Omega navigation positions from the CDU were manually logged every 12 hours during the operation of the receiver, and every 10 minutes during a 13-hour period (day 123-124).

Omega observation recordings on cassette tape were made during five, 24-hour time periods spread throughout the field program. Table 1 gives a list of the tapes accumulated and their approximate station locations, as derived from Transit satellite observations.

The 10-minute and 12-hour manually logged position determinations by the Omega receiver were compared with Transit positions and have been discussed, thus are not repeated here. This report describes the processing and further investigations into the data stored on cassette tape at CMC. As of September 1984, 60% of the tapes had been analysed. This is sufficient to portray the performance of the CMA771 ONS at high latitudes. Presently, we at UNB do not have the capability to read the cassette tapes. Time limitations on the availability of the processing equipment at CMC makes it unlikely that the remainder of the tapes will be processed.

2673 SMITH, J.N., ELLIS, K.M., and JONES, P. - 1984
Sellafield (Windscale) tracers in the Arctic Ocean; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 103.

The distributions of the radioactive tracers, Cs-134, Cs-137 and Sr-90 derived from the Sellafield (Windscale) fuel reprocessing plant on the West Coast of England, were determined in surface waters of the Norwegian Sea from analyses of sea water samples collected during the *CSS Hudson* cruise in 1982. Correlation of the spatial distribution of these tracers with their input function from the reprocessing plant provide information on water circulation processes in the Northeast Atlantic Ocean. Elevated levels of Cs-137 were detected in surface water at the FRAM III ice station in 1981, again due to inputs of Sellafield (Windscale) labelled water from the Norwegian Sea. An anomalously high Cs-137 activity measurement at a water depth of 1500 m at the FRAM III location is consistent with recent penetration of surface water to this depth. However, a Cs-137 activity profile measured at the CESAR ice station in 1983 does not indicate the presence of Sellafield (Windscale) labelled water at depths of the order of 1500 m.

2674 SWEENEY, J.F. - 1984
Arctic Tectonics - What We Know Today; *GEOS*, E.M.& R., vol. 13, no. 4, pp. 8-10. *CESAR Contr. No. 3.*

Discoveries from EMR's LOREX and CESAR expeditions help scientists piece together Arctic seafloor evolution.

2675 VAN WAGONER, N.A., and ROBINSON, P.T. - 1984
Petrography and geochemistry of the CESAR "Hard Rock": Possible implications for the origin of the Alpha Ridge; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 87.

During the CESAR expedition 20 bedrock samples were dredged from the walls of a major graben on the Alpha Ridge. These rocks represent the only bedrock ever recovered from the Alpha Ridge and, therefore, provide the only direct evidence for the nature, composition, and possibly origin, of the Ridge. All bedrock samples recovered were presumably similar in character, and were sent to institutions across Canada for analysis. This report is based upon the analysis of one of those samples.

The sample is a fragmental volcanic rock and, although it is highly altered, many primary textures are preserved. It comprises 85 to 90% clasts that are 0.5 to 4.0 mm in size and angular to subround in shape, although some rounding may be due to alteration. Rare clasts display curvalinear and vesicle-controlled boundaries. The rock is heterolithic and the three clast types observed are 1) brown to orangish-yellow, apparently aphyric, clasts (~93%), 2) yellowish-brown clasts containing subhedral pyroxene crystals that are 1-2 mm in size and constitute up to 30% of the clast (~5%), and 3) dark-brown clasts containing 3-5% plagioclase microlites up to 0.2 mm in length (~2%). Most of the clasts are moderately to highly vesicular or scoriaceous, but the third clast type tends to be moderately to sparsely vesicular. Vesicles generally are either 0.5 - 1 mm in diameter and apparently spherical in shape, or 2 - 4 mm in size and irregular in shape. Most fragments contain both types of vesicles. Vesicles are rarely elongate perpendicular to grain boundaries. The presence of plagioclase microlites and the absence of abundant relict crystals suggests the clasts were flossy to very fine-grained. Geochemical analyses are in progress.

The high vesicularity and vitric or very fine-grained nature of the clasts suggests shallow water, perhaps phreatomagnetic, eruption. The fragments may have been transported after initial deposition but little reworking is suggested because 1) Although the rock is heterolithic, a single clast type predominates, 2) Many of the grains are angular in shape, and 3) Any amount of reworking would be expected to result in the destruction of the delicate, scoriaceous clasts.

2676 VAN WAGONER, N.A., and ROBINSON, P.T. - 1985
Petrology and geochemistry of a CESAR bedrock sample: implications for the origin of the Alpha Ridge; *Geol. Surv. Can.*, Paper 84-22, pp. 47-57. *CESAR Contr. No. 12.*

During CESAR expedition, 20 similar bedrock samples were dredged from the walls of a major graben of the Alpha Ridge. These rocks are the only bedrock samples ever recovered from the ridge, providing the only direct evidence for its nature, composition and possible origin.

The sample analyzed is a highly altered fragmental volcanic rock which was rimmed with a crust of manganese oxide. Clasts form about 90% of the rock, are up to 1 cm, and are subround to angular. The rock is heterolithic comprising 92% aphyric, 5% clinopyroxenephyric, and 3% plagioclase-microphyric clasts. Plagioclase microlites display skeletal form. Clasts commonly contain 50 to 60% vesicles up to 4mm in size and spherical to irregular in shape. Some vesicles may be relict spherulites. The skeletal form of plagioclase microlites, lack of abundant relict crystals, and possible relict spherulites suggests volcanic fragments were glassy to very fine grained. The combined textural evidence (quench textures, high vesicularity, fragmental nature and small clast size) suggests that the volcanic fragments were erupted in shallow water during a phreatomagmatic or Plinian-type eruption.

Rare clinopyroxene phenocrysts comprise the only unaltered portion of the rock. The range of compositions of these phenocrysts is Wo_{51-53}, En_{32-37}, Fs_{12-16}, with significant amounts of Ca, Al, and Ti. These compositions are similar to clinopyroxenes of alkali basalts of Hawaii, Fanning Island and the Hess Rise. Geochemical discriminators also suggest a within plate tectonic environment.

2677 VAN WAGONER, N.A., and WILLIAMSON, M.C. - 1985
Tectonic Evolution of the Alpha Ridge: Geochemical Constraints; *Abstract in Geophysics*, vol. 50, no. 8, p. 1363. Presented at CSEG/CGU Convention.

During the CESAR (Canadian Experiment to Study the Alpha Ridge) 1983 experiment, the first bedrock samples were recovered from the Alpha Ridge. These samples are highly altered volcaniclastic rocks, but relict textures indicate the volcanic fragments were highly vesicular and glassy or very fine grained. Clinopyroxene compositions as well as whole rock trace, major, and rare earth element geochemistry, all indicate that the fragments are of alkali basalts. A possibly contemporaneous, but tholeiitic, sequence of primarily subaerial flows and volcaniclastic rocks is exposed on western and northern Axel Heiberg Island (Strand Fiord and Bunde Fiord areas) and northern Ellesmere Island (north Greely Fiord; Piper Pass area). These volcanic systems are apparently associated with the widespread intrusion of sills within Mesozoic strata of the Sverdrup basin. The Alpha Ridge has been proposed to be foundered continental crust, an ancient spreading center, a volcanic arc, an oceanic aseismic ridge, and the trace of a hot spot. These possible origins are based primarily on geophysical and/or physiographic constraints. Tectonic reconstructions have been developed which seem compatible with each of these origins for the ridge. Any hypothesis for the origin for the Alpha Ridge, and associated tectonic reconstruction, must be compatible with the new geochemical data made available by the CESAR experiment, and allow for the formation of contemporaneous on-land volcanic provinces. Highly alkaline basalts are not incompatible with a number of tectonic settings, but the probability of recovering these rocks is somewhat higher in some environments than in others. A model for the tectonic setting of the Alpha ridge, based on geochemical constraints will be presented and the possible relationship to the initiation of vulcanism in the Sverdrup Basin will be investigated.

2678 WALLACE, D.W.R., and MOORE, R.M. - 1985
Vertical profiles of CCl_3F (F-11) and CCl_2F_2 (F-12) in the Central Arctic Ocean Basin; *J. Geophys. Res.*, vol. 90, no. C1, pp. 1155-1166. *CESAR Contr. No. 2.*

The anthropogenic chlorofluoromethanes CCl_3F (F-11) and CCl_2F_2 (F-12) have been measured to depths of 1800 m in the Canada Basin of the Arctic Ocean (approximate position 85°50'N, 108°50'W). The measurements were made as part of the Canadian Expedition to Study the Alpha Ridge (CESAR) during April 1983. Surface layer concentrations beneath the ice were 4.79×10^{-12} mol/kg (F-11) and 2.11×10^{-12} mol/kg (F-12). Both profiles exhibit a rapid concentration decrease with depth through the halocline and very low, but detectable, concentrations at depths of 350-900 m in the Atlantic Layer. In the Arctic Ocean Deep Water (900-1800 m), concentrations are at or below our practical detection limit of 0.01×10^{-12} mol/kg. The profiles have been interpreted using two 'extreme-case' lateral ventilation models in order to place bounds on the water column ventilation rates. The "ventilation age" of the upper portion of the halocline (60-150 m) increases with depth from 4 to 14 years. The core of the Atlantic Layer at this location appears to have been isolated from the surface for at least 30 years.

2679 WALLACE, D.W.R., and MOORE, R.M. - 1984
F-11 and F-12 distribution in polar oceans; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 103.

Freon profiles collected in the Central Arctic Ocean during the CESAR project are presented. Measurable freon is present down to about 900 m in the Canada Basin while below this depth, the Arctic Ocean Deep Water has freon concentrations below our practical detection limit of 0.01 pM L^{-1}. The distributions are interpreted with the aid of 2 simple models that share the assumption that ventilation of the deep Arctic Ocean is principally by lateral or isopycnal processes. The models provide upper and lower bounds to the ventilation time-scales of the various layers of the water column and the results agree well with previous estimates based on other considerations. A residence time in the Arctic Ocean of about 30 years is estimated for the Atlantic Water at the CESAR location.

The Arctic Ocean profiles are compared with profiles collected from other polar regions, including the Greenland and Norwegian Seas, Baffin Bay, Jones Sound and Lancaster Sound. The penetration depth of the freons varies significantly from region to region. The physical reasons for this variation are examined.

2680 WEBER, J.R. - 1983
Alpha Ridge probe will increase understanding of Arctic resources; *Resource Development*, vol. 14, nos. 5 & 6, Winter 1982/83, pp. 10-12.

Scientists from the Department of Energy, Mines and Resources are planning a multidisciplinary geophysical and oceanographic expedition to study a submarine mountain range in the Arctic Ocean. The operation, code-named CESAR 83, for Canadian Expedition to Study the Alpha Ridge, will take place in the spring, coinciding with the 100th anniversary of the first International Polar Year.

2681 WEBER, J.R., and WELLS, D.E. - 1984
CESAR radiopositioning evaluation; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 104.

CESAR provided a unique opportunity to collect and evaluate radiopositioning data at high latitudes. Three kinds of radiopositioning data were collected during the CESAR field program: TRANSIT satellite navigation data (which provided the main source of reference positions for the CESAR camp); DECCA low-frequency navigation data, using the Polar Continental Shelf Project's DECCA chain, established along the north coast of Ellesmere Island, 500 km southeast of the CESAR camp; and OMEGA positions, using the Canadian Marconi 771 OMEGA receiver. The results of comparing both the DECCA and OMEGA with TRANSIT, taken as a standard, are presented.

2682 WEBER, J.R. - 1985
Crustal Section Across the Central Arctic Ocean; *Abstract in Geophysics*, vol. 50, no. 8, p. 1362. Presented at CSEG/CGU Convention.

A crustal model from the Fram basin across the Lomonosov ridge, Makarov basin and the Alpha ridge complex is presented based on Lorex, Cesar, Arlis II, and T-3 gravity and seismic data. The observed gravity field across the Alpha ridge can be fully explained in terms of water depth, a thin veneer of sediments in the valley troughs and a depth to Moho increasing from 15 km under the Makarov basin to 38 km under the central part of the Alpha ridge in agreement with seismic refraction measurements implying a remarkably uniform density structure for the entire 500 km wide Alpha ridge cross-section provided the crust/mantle density contrast is chosen to increase with depth from 0.24 Mg/m^3 under the Makarov basin to 0.4 Mg/m^3 under the deeper part of the Alpha Ridge. These density contrasts are similar to the ones obtained on a transect across the nearby continent to ocean transition zone from Cornwallis Island across Ellef Ringnes Islands into the Canada Basin.

2683 WELLS, D.E. - 1984
CESAR Radiopositioning analysis: Univ. New Brunswick, Dept. Surveying Engineering, unpubl. rep., 68 p. *CESAR Contr. No. R2.*

This is the final report of work performed under contract number OSU82-00430 entitled "CESAR radiopositioning evaluation", funded by the Earth Physics Branch of the Department of Energy, Mines & Resources.

The Decca chain used during CESAR produced observations at the CESAR camp which were biased by a few tenths of a lane (as well as two apparent lane slips). Treating these biases as calibration errors improves the agreement with Transit positions from a few thousand metres to a few hundred metres. Since a 0.01 shift in both Red and Green Decca readings results in a position shift of about 250 m at the CESAR camp, this is about as good as could be expected.

The Omega positions recorded manually during CESAR agree with Transit positions to within a few thousand metres. A strong diurnal signal is apparent in the Omega data, which presumably could be at least partly modelled out. The more detailed Omega data from CESAR being analyzed by Canadian Marconi Company may be useful in this respect.

CLIMATOLOGY

2684 ADAMS, P. - 1985
Research station on Axel Heiberg Island, Northwest Territories, Canada; *Polar Record*, vol. 139, pp. 431-433.

In 1959, after examination of the new air photographs, the late Dr. F. Müller led a small party to various locations on Axel Heiberg Island to select an area which would be appropriate to become a long-term base for high arctic research. The area around what is now known as Expedition Fiord, on the west side of the island, was selected. In 1960 two houses were built near the head of the fiord, beside Colour Lake. These formed the base for a number of major expeditions in the 1960s and for many field parties led by Dr. Müller and others up to the present day.

2685 ALT, B.T. - 1984
Preliminary Climate Reconstructions from Ice Core Data for the period 1800-1860 in the Queen Elizabeth Islands; Extended abstract submitted to Annual Meeting of Can. Com. on Climate Fluctuations and Man, 6 p.

The emphasis in the following will be on δO^{18} and melt percent, the two parameters measured in the ice core which have received the most attention to date. Mention will also be made of electrolytic conductivity and pollen concentrations.

We will examine data from ice cores on Devon Ice Cap and Agassiz Ice Cap in the eastern Queen Elizabeth Islands.

2686 ALT, B.T. - 1985
1550-1620: a Period of Summer Accumulation in the Queen Elizabeth Islands; *in* Climate Change in Canada 5, Syllogeus, no. 55, ed. C.R. Harington, Nat. Museums Can., pp. 461-479.

The Little Ice Age interval is generally considered to comprise the period 1550-1850. Time series of the O^{18}/O^{16} ratio and melt characteristics measured in ice cores taken from Canadian High Arctic ice caps provide an opportunity to investigate the climate of the Little Ice Age in the eastern Queen Elizabeth Islands.

2687 BARGE, B. - 1971
Synoptic Climate of Meighen Island; *Polar Cont. Shelf Proj.*, internal report, 41 p.

Meighen Island's position on the edge of the Polar Ocean results in a duality of climatic regimes. This is particularly evident in the summer temperatures. Figure 2.1 shows the July and August mean surface air temperature distribution over the area. In July the snow free islands of the archipelago are strongly heated while the archipelagic sea and continental shelf area of the Polar Ocean hover just above freezing. By August the zero degree isotherm has pushed south into the Beaufort Sea and the water area of the archipelago remains above freezing. The minus one degree isotherm approaches the continental shelf area.

2688 BRADLEY, R.S., and SERREZE, M.C. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap, Part I: mass balance; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 107-127.

Mass balance measurements have been renewed on two small ice caps on northeastern Ellesmere Island. Original stake networks were established in 1972 and 1976. Since then, both ice caps have experienced significant mass losses averaging -70 to -140 kg m ^{2}a. They have also decreased in area. The equilibrium line in this area has averaged around 1150 m for the last decade or so. The ice caps are remnants of former climatic conditions and are out of equilibrium with contemporary climate.

2689 BRADLEY, R.S., and SERREZE, M.C. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap, Part II: topoclimate; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 128-166.

Meteorological observations on and around a small, exposed plateau ice cap on northeastern Ellesmere Island, N.W.T., Canada were carried out in the summers of 1982 and 1983. The objective was to assess the effect of the ice cap on local climate as the melt season progressed. In 1982 seasonal net radiation totals were lowest on the ice cap and greatest at the site farthest from the ice cap. The ice cap site received only 35% of net radiation totals on the surrounding tundra. This reflects a gradient in albedo; albedo changed most markedly away from the ice cap as the summer progressed. A thermal gradient was observed along a transect perpendicular to the ice cap edge; this gradient was greatest at low levels (15cm) and was maximized under cloud-free conditions. The 'cooling effect' of the ice cap was less at the start of the ablation season than later. Low level inversions occurred more frequently over the ice cap than over the snow-free tundra. Overall, melting degree days on the ice cap were only 40-65% of those on the adjacent tundra. A model of interactions between the atmosphere and a snow and ice cover, or a snow-free tundra/felsenmeer surface is proposed. Observations indicate that the ice cap has a cooling effect on the lower atmosphere relative to the adjacent snow-free tundra; this effect is absent when snow cover is extensive (as in 1983). However, any cooling effect of the ice cap on adjacent areas involves heat flux to the ice which may eventually lead to enhanced ablation.

2690 BRADLEY, R.S., and EISCHEID, J.K. - 1985
Aspects of the precipitation climatology of the Canadian High Arctic; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. to Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 250-271.

Most precipitation in the High Arctic results from a relatively small number of discrete precipitation events. The synoptic circulation patterns giving rise to these events is investigated for significant precipitation (SP) events at Alert. Four major synoptic type sequences are shown to be important. Precipitation events are then examined in relation to temperature. Precipitation is positively correlated with temperature and, in winter, days with precipitation are significantly warmer than other days. The implications of these facts for the interpretation of ice core oxygen isotope records is investigated. There is no *a priori* reason why ice core oxygen isotope records should be related to mean annual temperature. Oxygen isotopes should reflect accumulation changes. The available data shows that this is only true for two periods in the Dye-3 record. Further research on the proper interpretation of ice core oxygen isotope records is needed.

2635 EDLUND, S.A., and ALT, B.T. - 1985
Congruence of regional vegetation and summer climate patterns in the Queen Elizabeth Islands, N.W.T. Canada; *Abstract in* Tech. and the Scientist, Proc. 1985 Arctic Science Conf., 36th Alaska Science Conf., Univ. Alaska, Fairbanks, Sept. 27-29, 1985, p. 179.

2636 EDLUND, S.A. - 1985
Lichen-free zones as neoglacial indicators on western Melville Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 85-1A, pp. 709-712.

2691 FLÜGEL, W-A. - 1981
The weather in Oobloyah Valley, northern Ellesmere Island, N.W.T., Canada, from 24th of June to 4th of August 1978, a statistical comparison of measured data; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 61-75.

The present report is a commenting description of the course of weather in Oobloyah Valley, Ellesmere Island in the Canadian Arctic. Therefore we analyzed the hourly series of values of two weather stations according to their similarity. As most adequate form we chose the figuring of the daily means out of the 24-hour values. In spite of irradiation which kept on for 24 hours, we could make out a daily course of air temperature and air humidity, which was highly restricted to the radiant weather periods. The statistical analysis of the series of values presented high correlations be-

tween temperature and air humidity, but not to the velocity of wind. This points out to the dominating weather-forming influence of the degree of cloudiness and its temporary course. The weather happening can be devided into a period of evident radiant conditions during the first half of July and into the fading out warm weather period with frequent cloudiness during the second half of July. The high precipitations begin August leads to the arctic winter. A comparison between the means of July temperature and precipitation with neighbouring stations shows that the values deviate only insignificantly which we can explain by the location of the weather stations.

2692 HAYTHORNTHWAITE, T.W. - 1984
The relationship between open water and temperature in the Canadian Arctic Archipelago; *Polar Cont. Shelf Proj.*, internal report, 44 p.

Open water in the Canadian Arctic Archipelago is shown to be a good indicator of air temperature during the summer months. The results, based on annual maximum data for the open water seasons from 1961 to 1978, and on weekly data for the seasons from 1975 to 1982, are compared to mass balance data for the same periods from the Devon Island Ice Cap. The implications of these techniques for future research are discussed.

2693 KING, L. - 1981
The summer 1978 in northern Ellesmere Island: A comparison of climatic records of weather stations; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 77-107.

The weather data of our station NEIL PENINSULA are analysed and compared with the values of EUREKA, ALERT and RESOLUTE BAY. This and an additional comparison with the data of all the stations of the Polar Continental Shelf Project in the eastern Canadian Arctic during summer 1978 show that similar high maximum air temperatures as measured at NEIL PENINSULA, can also be registered at other stations which are situated in the Eureka/Lake Hazen area. This climatic region shows comparatively strong continentality due to the surrounding high mountain ranges of Axel Heiberg Island and Central and Northern Ellesmere Island. The surrounding climatic regions are characterised by lower mean minimum temperatures and a considerably lower sunshine duration. These results may be confirmed with the data of the stations LAKE HAZEN, TANQUARY, VAN HAUEN and ISACHSEN.

A second comparison shows, that temperatures in July 1978 were slightly above and in August 1978 slightly below the long year means. It is also pointed out, that morphologically active periods due to heavy rain may even occur in the second part of August. Typical synoptic types are displayed.

There is a clear contrast between the weather data of coastal and inland stations. All official weather stations (e.g. EUREKA, ISACHSEN) and LAKE HAZEN show a strong cooling influence by large water bodies. "Inland weather" is recorded at TANQUARY, EXPEDITION FIORD and especially at numerous other P.C.S.P. stations every year. This valuable data and the mentioned differences to coastal station data deserve increased interest in ecological studies.

2694 KOERNER, R.M., and FISHER, D.A. - 1985
The Devon Island ice core and the glacial record; *in* Quaternary Studies on Baffin Island, Baffin Bay and west Greenland, ed. J.T. Andrews, pp. 309-327. Allen and Unwin, Boston, 774 p.

Ice cores are repositories of past atmospheric conditions at each ice cap drill site. Ice core parameters are an integration of atmospheric conditions obtained along the entire air mass trajectory of the parameter studied, be it water vapour (O-18), dust, chemical elements, or pollen. Thus ice cores provide valuable proxy data for studies of climate change.

2695 LeDREW, E.F. - 1983
Arctic weather; *GEOS*, E.M.R., vol. 12, no. 2, pp. 6-9.

Arctic weather processes have a profound effect on global climate, way out of proportion to the surface area in which they originate. Small changes in temperature are amplified in both polar regions, and air currents carry their effects to temperate latitudes - possibly even across the equator. To understand this process better, meteorologists are developing numerical models, incorporating satellite data, to describe and eventually to predict Arctic climate and weather systems.

2639 LICHTI-FEDEROVICH, S. - 1985
Diatom dispersal phenomena: diatoms in rime frost samples from Cape Herschel, central Ellesmere Island, Northwest Territories; *in* Current Research, Part B, Geol. Surv. Can., Paper 85-1B, pp. 391-399.

2696 OHMURA, A. - 1984
Comparative Energy Balance Study for Arctic Tundra, Sea Surface, Glaciers and Boreal Forests; *GeoJournal*, vol. 8, no. 3, pp. 221-228.

Seasonal change in the energy balance on the arctic tundra is presented. The thermal stability of a dry snow cover is investigated in detail. In addition to high reflection by the snow cover, a significant absorption of solar radiation on the very surface of the snow cover was found responsible for the thermal stability. The efficient absorption of solar radiation by the surface rather than the interior of the snow cover and the almost immediate removal of the absorbed energy through radiative emission and turbulent heat fluxes keep the temperature of the snow cover low.

The energy balances for the melt and postmelt period for various arctic surfaces are compared. The most important difference of the energy balance between the tundra and other low altitude arctic surface, such as the sea and ablation areas of glaciers, is not the net radiation but the latent heat of fusion. Extremely small heat consumption through the melt on the tundra is the basis for higher temperature, characteristic to the tundra climate in the Arctic.

2697 OHMURA, A. - 1984
Regional water balance in the mountainous Arctic and its application for water-resource planning; *in* Applied Climatology, Proc. 25th Inter. Geographical Congress, Sym. No. 18: Applied Geography, eds. W. Kirchhofer, A. Ohmura and H. Wanner, Zurich, August 20-21, 1984, pp. 67-77.

The natural cause for the freshwater shortage at arctic settlements is attributed to small precipitation and relatively large evaporation on the ground. Most of the annual evaporation takes place during the short snow-free period in summer, when the freshwater demand is high. During this period the evaporation exceeds precipitation at most arctic coastal settlements.

The author found in the western part of Axel Heiberg Island, N.W.T. that water balance on arctic tundra varies considerably with altitude, the precipitation exceeding the evaporation above 500 m a.s.l.. The specific runoff at altitudes between 500 and 800 m was found to be ca. 20 mm or 2.10^4 m^3 discharge from 1 km^2 drainage basin, which is sufficient to support a population of fifty at the current water consumption rate in the Canadian Arctic.

As a second alternative the possibility of tapping glacier melt water was investigated. The average specific ablation in summer in the Queen Elizabeth Islands lies between 20 and 30 cm or 3.10^5 m^3 discharge from a glacier of 1 km^2 surface area, which meets the annual demand for a population of eight hundred.

2698 OHMURA, A. - 1984
On the cause of 'Fram' type seasonal change in diurnal amplitude of air temperature in polar regions; *J. Climatology*, vol. 4, pp. 325-338.

The cause of 'Fram' type seasonal trend of diurnal amplitude of air temperature is investigated from the viewpoint of the surface energy balance. First, the cause of diurnal amplitude of the surface temperature is examined. Then, the effect of the atmosphere between the surface and the screen-level on the amplitude of air temperature is evaluated.

The data of the energy balance used in this work were collected at the base camp of the Axel Heiberg Island Expedition (79°25'N, 90°45'W, 200 m) in the Queen Elizabeth Islands, N.W.T., Canada. This site shows a typical 'Fram' type trend of diurnal amplitude with annual maximum in April, the summer minimum in June and a secondary peak in August.

The April maximum is due to extremely slow sublimation and heat conduction in the subsurface. The decrease in the amplitude during the later dry snow period in May and early June is due to a gradual increase in sublimation which is induced by the temperature increase. During the melt in June, the diurnal amplitude of the surface temperature is effectively reduced owing to the diurnal change of the latent heat of fusion. After the snow melt, the diurnal amplitude of absorbed global radiation is tripled compared with April. The temperature amplitude remains small, however, owing to the rapid increase in the diurnal amplitudes of energy sinks. The cause of the slight recovery of the diurnal temperature amplitude in August is the decrease in the sensible heat flux.

Throughout the entire period, the result of the heat exchange is reflected in a larger temperature variation under lower temperature due to the Stefan-Boltzmann law. This effect contributes to a larger diurnal amplitude in spring.

2699 PALECKI, M.A., SERREZE, M.C., and BRADLEY, R.S. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap: Part V: boundary layer conditions; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 217-249.

Thirty-nine low altitude (<400 m) soundings were made over St. Patrick Bay Ice Cap (81°57'N, 64°13'W) during June and July 1983. Measurements of dry-bulb and wet-bulb temperature, wind direction and speed and air pressure were made by a radio-equipped instrument package suspended from a tethered, helium-filled balloon. Flights took place in predominantly anticyclonic conditions. The data present a unique, high-resolution, view of conditions in the boundary layer above a near isothermal snowpack on a high altitude plateau in the Arctic. Case studies of the flights reveal a variety of macro-, meso-, and microscale processes affecting the local atmospheric conditions, and, thus, the energy and mass balance of the ice cap.

2700 SERREZE, M.C., and BRADLEY, R.S. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap Part III: radiation climatology; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 167-194.

Hourly measurements of incoming shortwave and longwave radiation, surface albedo and net radiation were made on an unshaded plateau ice cap on northeastern Ellesmere Island, in the summers of 1982 and 1983. Incoming shortwave radiation (Qi) is strongly dependent on solar angle whereas this is not so for incoming longwave radiation (Ii). All cloud types increase Ii, especially low dense clouds, snow and fog. Relative transmission of Qi is high in all cloud types compared to clouds at lower latitudes. With high surface albedo (>0.75) net radiation (R) is strongly and positively correlated with net infra-red radiation (In) but shows little relationship to net shortwave radiation (Qn). By contrast, with low surface albedo (<0.20) R is negatively correlated with In but positively related to Qn. Under high albedo conditions, an increase in cloud cover leads to higher values of R but under low albedo conditions R decreases as cloud cover increases. Maintenance of snow cover is favored by the normal seasonal progression of albedo and cloud cover changes (high albedo, clear skies to low albedo, cloudy conditions) which occur in the arctic.

2701 SERREZE, M.C., and BRADLEY, R.S. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap: Part IV: energy budget; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 195-216.

Measurements of energy budget terms were made at 850 m on a small ice cap and on a nearby tundra/felsenmeer surface in June and July 1983. Both sites remained snow-covered for most of the season. Sensible and latent heat fluxes were larger over the ice cap, probably due to high wind speeds resulting from smoother surface conditions. Sensible heat flux at both sites showed diurnal variations related to changes in stability in the lower atmosphere (15-150 cm). Over the ice cap, sensible heat flux was generally directed downward due to the strong inversions commonly present there. Sensible and latent heat terms were markedly different with changes in airflow over the region. Totals of energy budget terms at the ice cap stations for the period of record are presented.

GENERAL

2702 BERTULLI, M. - 1985
The Northern Heritage Research Project: an applied approach to research and education in the Northwest Territories; *Laurentian Univ. Review*, vol. XVIII, no. 1, pp. 65-74.

Until recently, scientific endeavours in the North consisted largely of brief forays by scholars from southern institutions who had little contact with local communities during the research process. However, in the past few decades scientists working in the North, as elsewhere, have become increasingly sensitive to the social context in which they work. Northerners have assumed an active role in determining the scope and rate of development and research done in the north, as well as in performing research themselves.

2703 BIELAWSKI, E. - 1984
Anthropological Observations on Science in the North: The Role of the Scientist in Human Development in the Northwest Territories; *Arctic*, vol. 37, no. 1, pp. 1-6.

The social context of research provides the background for assessing present and potential roles scientists may play in the Northwest Territories. This context includes diverse cultural and interest groups and an ever-quickening pace of social change. Increasing scholarly and ethical demands are being placed on the scientific community for academic accountability, public participation, education, and cross-cultural exchange of knowledge. These demands affect us, our disciplines, and our ability to carry on research.

The Northern Cultural Heritage Project, an applied anthropology and archaeology program, serves as a case study illustrating the integration of research with the northern social context. Additional potential roles for researchers are discussed, including increasing information return, education through exposure to field science work, research ethics and social context awareness for novice professionals, and policy participation. It is concluded that the contemporary social context of the north has practical and perhaps theoretical implications for the conduct of science.

2704 BOROWIECKI, A. - 1984
U of A Geographists Study Arctic Glaciers; *the Summer Times*, vol. IX, no. VII, Thursday, July 12, 1984, p.1.

This is the first of a two part feature dealing with the controversial Ellesmere Island. The first part deals with a six-week expedition to that region co-ordinated by Dr. John England, the geography department's foremost authority on Arctic environments.

To learn more about the controversies surrounding Ellesmere Island, *Summer Times* interviewed Dr. England, a veteran of 16 arctic expeditions, and Dr. Jan Bednarski with five years of experience in arctic research. Adding a different perspective to the interview were graduate students Tom Morris and Malcolm Brown.

2705 BOROWIECKI, A. - 1984
Will Park Become Tourist Trap?; *Summer Times*, Univ. Alberta, vol. IX, no. VIII, Thursday, July 19, 1984, p. 3.

2706 BRUEMMER, F. - 1984-1985
Arctic inferno - Witches' brew spews acid rain across the tundra; *Canadian Geographic*, vol. 104, no. 6, pp. 70-75.

Fanned by east winds, the Smoking Hills of the Arctic burn and smoulder, clouds of sulphur dioxide-laden vapour ooze from fissures and fumaroles and spread like a gray-blue haze across the lake-dotted tundra. It is an evil, acid haze. The smoke plume, in addition to sulphur, contains arsenic, selenium, antimony and bromine. The ponds in its path are among the most severely polluted bodies of water in the world. The water is so acid, it tastes sour.

For once, man is not to blame. The Smoking Hills are an extremely rare but natural phenomenon. The 100-metre high sea cliffs south of Cape Bathurst, facing Franklin Bay, about 250 km, east of Tuktoyaktuk in the western Arctic, contain abundant but microscopic pyrite (iron sulphide) and black bituminous shale. Exposed to air, the pyrite, because of its fine particle size and, thus, large surface area, ignites spontaneously and burns together with the shale within the cliff.

2707 KING, L. - 1981
Maps, geographical names and discovery of Borup Fiord and surroundings, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 15-33.

Borup Fiord has been discovered in 1915 by W.E. EKBLAW, and most geographical names of the area origine from then A sketch map by EKBLAW is published here, probably for the first time. A better topographic knowledge was obtained in 1947 by the Polaris photography. Complete stereophotographic coverage was obtained in 1950 (Trimetrogon imagery) and in 1959/60 (verticals) and allowed the compilation of better topographic maps. After 1956, geologic, geophysical and oceanographic activity followed. The location of an abandoned well drilled in 1974, of seismic lines and measured water depths is displayed.

During the Heidelberg Ellesmere Island Expedition a

great number of objects have been mapped and photographed and numerous published and unpublished terrestrial and aerial photographs and terrestrial photogrammetry exist now. An orthophotomap and a geomorphological map (both 1:25 000) are published in this volume, and there is also an unpublished map 1 :5 000 with 5 m contours covering the area between the head of Oobloyah Bay and Arklio River based on low level verticals of the expedition area taken in 1978. For description purposes new geographical names have been introduced by our expedition in cooperation with the Canadian Permanent Committee on Geographical Names.

2708 LEHN, W.H. - 1983
Temperature Profiles Computed From Superior Mirage Observations; *Technical Digest* (Meteorological Optics), Optical Soc. of America, Winter '83 Meeting, January 12-14, pp. FC1: 1-4.

The superior mirage is seen under conditions of temperature inversion. If the vertical atmospheric temperature profile is known, the computer simulation of such observations is relatively straightforward; but in most cases the necessary information is not available. However, with suitable assumptions, this distribution can be deduced from the mirage of a known object.

2709 McNEELY, R., and GUMMER, W.D. - 1984
A Reconnaissance Survey of the Environmental Chemistry in East-Central Ellesmere Island, N.W.T.; *Arctic*, vol. 37, no. 3, pp. 210-223.

Snow-pack and surface water samples were collected from east-central Ellesmere Island near Cape Herschel between May and August in 1979-81 to ascertain whether anthropogenic pollution was detectable in a remote "pristine" arctic environment. Snow-pack samples were analyzed for organochlorine pesticide residues, polynuclear aromatic hydrocarbons, and chlorophenoxy acid herbicides. Precipitation and surface water samples were analyzed to determine whether the region has been subjected to "acid rain". In addition, the surface water samples were analyzed for as many as 35 inorganic parameters to provide background data on the water quality of the region.

Measurable concentrations of Lindane (γ-BHC) and its isomer α -BHC, HEOD (dieldrin), and DDT were detected at a number of sites, but no polynuclear aromatic hydrocarbons (PAHs) or chlorophenoxy acid herbicides were detected. The pattern of pesticide residues observed in arctic snowpack is similar to that present in precipitation in southern Canada, although the concentrations are lower. The presence of a variety of pesticide residues in this remote area of the Arctic is presumptive evidence that the residues are globally dispersed through the atmosphere. Only copper and the lithophilic metals aluminum and iron were consistently detectable in the snow-pack and surface water samples; all other metals were at or below their detection limits. Thus anthropogenic inputs of metal contaminants such as arsenic, cadmium, lead, mercury, selenium, and vanadium, via atmospheric deposition, were not detected in this region. Although "acid rain" was not in evidence in the study area, the surface waters of the local ponds and lakes, many of which are ombrogenic, are potentially susceptible to changes in the acidity of the atmospheric aerosol of the high Arctic.

2710 PRYTZ, K. - 1983
Vaktmesteren på nordpolen; *Horisont saa norge*, vol. 2, pp. 14-16.

Snekker og minkoppgretter Leif Lundgård fra Vang pa Hedemarken var 38 ar gammel da en kamerat lot ham bli med på en bremåling på Baffinland noen måneder. I hui og hast laerte han seg sitt første engetske-ord: "Yes".

2711 SCOTTER, G.W. - 1985
Priority areas chosen for preserving Arctic oases; *Can. Geographic*, vol. 105, no. 1, pp. 64-69.

Why do we need parks in the North? How many should be created? Are there priorities for any of them? Which is your favourite? Some questions are easy to answer; others are more difficult. As one of a small team that has studied several potential national park areas in the North in the past decade, I have particular trouble deciding which area is my own favourite.

In the early 1970s, Parks Canada developed a plan to select new parks to ensure that the park system eventually will represent all major natural regions of Canada; 48 such regions were identified, of which 39 are terrestrial and nine are marine.

2712 TAYLOR, H.W., GIBBINS, W.A., and SVOBODA, J. - 1983
Gamma radiation from camera lenses; *Radiation Protection Dosimetry*, vol. 5, no. 3, pp. 187-188.

The radioactivity due to ^{232}Th in some camera lenses has been investigated. It is deduced that an annual dose to the abdominal wall of professional photographers of the order of a few tens of mrad is quite possible.

2713 WARDELL, G.E., and OSBORNE, D. - 1982
The Irish Arctic Expedition 1981 report; *Polar Cont. Shelf Proj.*, internal report, 124 p.

The Irish Arctic Expedition 1981 spent five months in Northern Ellesmere Island, the most northerly landmass in the Canadian Arctic Archipelago, carrying out scientific research and surveys in previously unvisited territory. It is the first polar expedition to be organised and launched from this country although a definite precedent had been set by such notable early explorers as Admiral Sir Leopold (Paddy) McClintock and Ernest Shackleton.

GEOLOGY

2648 AKSU, A.E., and MUDIE, P.J. - 1985
Magnetostratigraphy and palynology demonstate at least 4 million years of Arctic Ocean sedimentation; *Nature*, vol. 318, no. 6043, pp. 280-283. *CESAR Contr. No. 5.*

2649 AKSU, A.E. - 1985
Paleomagnetic stratigraphy of the CESAR cores; *Geol. Surv. Can.*, Paper 84-22, pp. 101-114. *CESAR Contr. No. 14.*

2650 AKSU, A.E. - 1985
Planktonic foraminiferal and oxygen isotopic stratigraphy of CESAR cores 102 and 103: preliminary results; *Geol. Surv. Can.*, Paper 84-22, pp. 115-124. *CESAR Contr. No. 15.*

2651 AMOS, C.L. - 1985
Bottom photography and sediment analyses on CESAR; *Geol. Surv. Can.*, Paper 84-22, pp. 25-45. *CESAR Contr. No. 11.*

2714 ANDREWS, J.T., MILLER, G.H., VINCENT, J-S., and SHILTS, W.W. - 1984
Quaternary correlations in Arctic Canada; *in* Quaternary Stratigraphy of Canada - A Canadian Contribution to IGCP Proj. 24, ed. R.J. Fulton; Geol. Surv. Can., Paper 84-10, pp. 127-134.

In the Hudson Bay/James Bay Lowlands, along the coasts of Banks Island, and along the eastern coast of Baffin Island are continuous and extensive sections in Quaternary sediments. These sections are rich in marine fossils, buried peats, and soils and contain a wide variety of glaciagenic sediments together with glacial marine units and littoral deposits. Lake muds are also fairly common. All three areas possess very long records that may extend to the early Quaternary and Pliocene.

The events of the last glaciation (Wisconsinan, Foxe, Amundsen) are interpreted in terms of lithostratigraphy, biostratigraphy, and aminostratigraphy. Relative and "absolute" dating control is provided by radiocarbon dating of events that span the last 50 ka, and in particular the last 11 ka, and some age control is also provided by several U-series dates on marine molluscs. Regional correlations are based on comparisons of amino acid ratios from marine shells.

2715 ASPREY, K.W., and JOHNSTON, B.L. - 1983
Report on C.S.S. Hudson Cruise 83-028, Baffin Island Fjords; *Geol. Surv. Can.*, Atlantic Geoscience Centre internal report, 189 p.

HUDSON cruise 83-028 is the second of three sister cruises to Baffin Island under the Sedimentology of Arctic Fjords Experiment (SAFE). The project was initiated by the Geological Survey of Canada at the Atlantic Geoscience Centre (BIO, Dartmouth) under project SYVITSKI 810042. The program to date includes participation by three federal government departments and several universities. SAFE is a comprehensive study on the climatology, hydrography, physical oceanography, sediment dynamics, sedimentological history, and animal sediment relationships of Arctic Fjords.

The final product of this survey will be a workable model that can be used to predict the fate of natural sediment with inference to waste disposal - a problem of increasing significance with northern development. The cross-discipline coordination and site study by all scientists at the same time is the aim and advantage of SAFE.

2716 BALKWILL, H.R., and FOX, F.G. - 1982
Incipient rift zone, western Sverdrup Basin, Arctic Canada; *in* Third Inter. Sym. on Arctic Geology, eds. A.F. Embry and H.R. Balkwill, Can. Soc. Petroleum Geologists Memoir 8, December 1982, pp. 171-187.

Normal faults, linear magnetic anomalies, gabbro dikes, aligned evaporite domes, and modern earthquake epicentres define a broad tectonic belt in upper Paleozoic and Mesozoic rocks of western Sverdrup Basin. From Melville Island, at the southern margin of the basin, the belt strikes northeastward, toward the continental margin, at northern Ellef Ringnes Island.

The age and geometry of the structural elements indicate that the belt represents a long-lasting domain of crustal dilation, as an incipient rift in the northern margin of the craton. Fracture systems, developed from dilation along the belt, could have served as conduits for migrating hydrocarbons, contributing to large natural gas accumulations at Sabine Peninsula, King Christian Island, and western Ellef Ringnes Island, and oil and gas under the offshore regions between the islands.

2717 BALKWILL, H.R. - 1983
Geology of Amund Ringnes, Cornwall, and Haig-Thomas Islands, District of Franklin; *Geol. Surv. Can.*, Memoir 390, 76 p. & 3 maps.

Amund Ringnes, Cornwall, and Haig-Thomas islands are in the south-central part of the Sverdrup Basin, a large pericratonic depression in the Canadian Arctic Archipelago containing upper Paleozoic, Mesozoic, and Cenozoic marine and nonmarine sedimentary rocks. Strata exposed on those islands, and penetrated by drillholes, consist of alternating thick successions of sandstone, siltstone, and shale, ranging from possibly Middle Triassic to Upper Cretaceous; the exposed succession is about 5000 m thick. Sediments forming those terrigenous clastic rocks were transported to the basin mainly from source terrains south and east of the basin margin. Gabbro dykes and sills have intruded Mesozoic rocks on both Amund Ringnes and Cornwall islands; radiometric ages for the intrusions range from about 144 Ma to about 117 Ma. The intrusive rocks reach progressively higher in the stratigraphic succession toward the basin depocentre; this and other considerations lead to the suggestion that phases of mafic intrusion accompanied accelerated rates of crustal subsidence and sedimentation.

2718 BALKWILL, H.R., COOK, D.G., DETTERMAN, R.L., EMBRY, A.F., HAKANSSON, E., MIALL, A.D., POULTON, T.P., and YOUNG, F.G. - 1983
Arctic North America and Northern Greenland; *The Phanerozoic Geology of the World, II The Mesozoic B*, Elsevier Science Publishers, pp. 1-31.

Mesozoic rocks occupy a broad belt across Arctic North America, from northern Alaska, through the Canadian Arctic Archipelago, to eastern North Greenland, and occur also to the south through the northern interior regions

of Canada and along the margins of Baffin Bay. They are found in a wide variety of physiographic settings, from glacier-covered mountains to featureless plains and submerged, ice-bound continental shelves. Thus, our knowledge of the Mesozoic is based on data that are highly variable in quality and quantity from place to place, derived from abundant excellent exposures in some areas, poor exposures in others, and limited well data and seismic profiles in still others. Along the Arctic continental shelf, seismic surveys and well control available in some places indicate that a relatively thick section of Mesozoic strata underlies much of the area. Further information on the Mesozoic will be slow in coming from the continental shelves, where drilling logistics are formidable due to the shifting Arctic ice pack, and Tertiary cover is as thick as 8 km.

In this paper, the Mesozoic history of Arctic North America is outlined from known land geology. None of the numerous regional tectonic models which have appeared in the literature to date is widely accepted by geologists familiar with the rocks, nor can any be adopted with confidence. The interpretations of the Mesozoic stratigraphy have evolved for the various areas mainly through the efforts of national geologic agencies (United States Geological Survey, Geological Survey of Canada and Geological Survey of Greenland). Macrofossils, especially ammonites, are the main basis for age determinations and correlations of the marine sedimentary rocks, although with the recent accumulation of well samples and interest in nonmarine coal deposits, micropaleontology and palynology are beginning to supply much biostratigraphic data. For most of the region, biostratigraphic control is good and future work will result in only minor changes. In a few areas, where only reconnaissance work has been done, major changes and additions can be expected.

2653 BARRON, J.A. - 1985
Diatom biostratigraphy of the CESAR 6 core, Alpha Ridge; *Geol. Surv. Can.*, Paper 84-22, pp. 137-147. *CESAR Contr. No. 17.*

2719 BARSCH, D., and KING, L. - 1981
Aims and program of the Heidelberg Ellesmere Island Expedition 1978; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 1-14.

Research in arctic areas is a duty shared by all countries with a good scientific infrastructure. One main reason certainly is, that in arctic areas we still can find ecological and especially geomorphological processes that during the Ice Age formed large areas of today temperate regions. Many landscapes in our vicinity represent, concerning their physiognomy, striking examples of "fossil polar regions". The aim of the HEIDELBERG ELLESMERE ISLAND EXPEDITION, whose results are represented in this volume, was therefore to study part of the processes that formed large areas of central Europe during the last Ice Age and that are insofar responsible for the natural potential of these regions.

Research in the Canadian Arctic is done very thoroughly during the last 30 years. In the last years the number of research groups supported by the Polar Continental Shelf Project, Ottawa is about 150 per year, and consists of small or large parties of geographers, geologists, climatologists, biologists, glaciologists, hydrologists, ethnologists and oceanographers. Many more parties start from stations in the Mackenzie Delta, Keewatin, Hudson Bay area, Quebec/Labrador and southern Baffin Island. Some parts of the Canadian Arctic have been very intensely and regularly studied during the last 20 years, in some cases by dozens or even hundreds of scientists, as Expedition Fiord on Axel Heiberg Island, Truelove Lowland on Devon Island, Tuktoyaktuk or Inuvik in the Mackenzie Delta area. Conscious about the fact that we are newcomers, we dared to choose an area that hasn't been studied geomorphologically before. Beside the scientific results we intended to get, this decision should allow to contribute also to better local knowledge of a little known area in our host country.

2720 BARSCH, D. - 1981
Geomorphology of the expedition area Oobloyah Bay, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 109-122.

The expedition area Oobloyah Valley is a broad syncline running E-W. The relief towards the N (Krieger Mtns.) is of a high alpine type with valley glaciers, steep slopes and arretes; towards south the lower mountains of the Neil Peninsula with ice caps and more or less gentle slopes are forming a mountaineous type of relief. The floor of the syncline is an accumulation plain, which seems to be of a complex formation. There are indications, especially from C-14 dates, that the accumulation in these parts started well before the maximum ice advance at the southern fringe of the Wisconsinan ice sheet (ca. 18. 000/20. 000 B.P.). In addition, the walls of the Oobloyah valley do not show prominent glacial features. Therefore it seems that the Oobloyah Valley has not been glaciated around 20,000 B.P. That corresponds with the NE fringe of the Wisconsinan ice sheet, and it fits with the model of ENGLAND; BRADLEY & ENGLAND for N Ellesmere. The deep fiords and the erractics on Neil Peninsula are perhaps only indications for at least one former bigger glaciation. The landforms in Oobloyah Valley (slopes etc.) are well adapted to a periglacial environment. This is probably due to the fact that their development took a longer time than hitherto assumed and not only to a very high periglacial activity.

Following the dates for raised beaches of other parts of northern Ellesmere Island the valley plain (ca. 75 m a.m.s.l.) has been formed around 7,000 B.P. Even if the sedimentation of the sandy material started well before 20,000 B.P. it is possible that around 7,000 B.P. the uppermost part of this plain has been formed in relation to the sea level of this time. Therefore our old C-14 dates are related to the age of the sediment and not necessarily to the age of the form.

According to the hypothesis of excessive valley formation in Polar regions we have to expect regular long profiles for rivers. That is not the case in the

Oobloyah Bay region. The lower parts of Heidelberg and Nukapingwa river are steep and irregular. Fluvial valley formation has been relatively slow, despite high transportation rates. The area can therefore be looked upon as a region formed by high arctic periglacial processes of a probably long duration with low intensity of fluvial downcutting, but partly strongly influenced by glacial activity.

2721 BARSCH, D. - 1981
Studies on the recent morphodynamic in the Oobloyah Bay region, northern Ellesmere Island, N.W.T., Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 123-161.

The recent geomorphodynamic situation of an area or the importance of recent geomorphological processes in a special region is difficult to measure exactly. That is extremely true for the high Arctic. Size and order of the relief-forming processes in an area as the Oobloyah Valley have to be only semi-quantitative estimations. Even if these estimations are not free of faults and errors, it seems urgent to try to get these information to develop more and better quantitative geomorphological models. For the expedition area some data could be gathered; they are not perfect, but it is believed that the values given are correct for the test area regarding their order of magnitude.

2722 BARSCH, D. - 1981
Terraces and fluvial activity in relation to the model of excessive valley formation in the Oobloyah Bay region, northern Ellesmere Island, N.W.T., Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 163-201.

Two major rivers of the Oobloyah Valley have been studied: the Heidelberg and the Nukapingwa River. Both developed major terrace-complexes with 8 (Heidelberg River) and 7 (Nukapingwa River) steps; both are influenced by the Holocene sea level changes, and both are meltwater streams with a glacial regime.

The Heidelberg River basin is about 180 km^2, that of the Nukapingwa 9, 7 km^2. The mean transport of the Heidelberg River is (1978) about 80,000 t/a, the erosion rate 0.17 mm/a (related to solid bedrock with 2.65 t/m^3). The Nukapingwa transports (1978) around 8,000 t/a, its erosion rate has been calculated to 0.3 mm/a (related to solid bedrock with 2.65 t/m^3).

If the valleys of the two rivers have been formed during the last 7,000 years, only 5-10% of their annual transport has been derived by fluvial erosion in their own valleys. Therefore, in their lower parts, both valleys are steep and irregular. Thus, both valleys are not in accordance with the theory of BÜDEL, that in Polar regions under a periglacial climate by excessive valley formation all valleys are grading smoothly to the sea. That shall be true despite all disturbances by sea level fluctuations.

In the Oobloyah Valley this hypothesis of valley formation cannot be confirmed. Even rivers with a high capacity (and a high transport) show no sign of an excessive erosion into depth, but only into width. It is therefore proposed that the local dynamic and geomorphological situation should be studied along Arctic rivers of different regions in order to be able to decide, if the model proposed by BÜDEL is true generally or only under special conditions.

2723 BARSCH, D., and MÜLLER, G. - 1981
Recent iron ore deposition and heavy metal accumulation in Access Lake, Oobloyah Valley, northern Ellesmere Island, N.W.T., Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 507-520.

During the Heidelberg Ellesmere Island Expedition 1978 two sediment cores have been taken in Access Lake in order to get information on recent sedimentation in a high arctic periglacial environment. The core from the center of the lake revealed a very low rate of clastic sedimentation but extremely high iron concentrations as a result of limonite deposition.

The deposition of the iron rich (limonitic) sediment is a result of the formation of iron oxihydrates in the catchment area of the lake caused by leaching of iron containing minerals by decomposing organic material. Subsequent oxidation and precipitation of iron oxihydrates from solutions entering the inflows of the lake and a short fluvial transport of the colloidal iron rich fractions lead to the accumulation of a limonitic mud in the deeper parts of the lake.

Iron rich lake sediments - as crusts and nodules - have been known since long from numerous subarctic lakes. The iron muds of Access Lake represent - regarding climatic zone and mode of deposition - a new type of lacustrine sediments enriched in iron.

A heavy metal distribution pattern similar to those in sediment profiles in more polluted areas was found. A longrange transport of anthropogenic heavy metal via atmospheric dust - as already reported from snow and ice in polar regions - is assumed to be the source of the heavy metal accumulation in Access Lake.

2724 BEDNARSKI, J. - 1984
Glacier Fluctuations and Sea Level History of Clements Markham Inlet, Northern Ellesmere Island; Unpub. Ph.D. thesis, Univ. Alberta, 232 p.

Clements Markham Inlet is a major re-entrant on the northernmost coast of Ellesmere Island which cuts into the Grant Land Mountains. The head of the Inlet is bounded on three sides by mountain ice caps. However, a 30 km belt of ice-free uplands occurs along the outer part of the Inlet. Lowlands at the head of the Inlet are also ice-free and are characterized by extensive raised marine deposits. Fieldwork and mapping provides a scenario of former glacier behavior, especially the pattern of ice retreat from confluent positions at the head of the Inlet. Over 40 radiocarbon dates on driftwood and marine shells are used to develop a chronology and to reconstruct the history of sea level.

High-level ice marginal channels and mountain summit erratics indicate that old glaciations inundated the whole of Clements Markham Inlet. At least one of these unda-

ted glaciations flowed unconstrained by the local topography and inundated the entire region. In contrast, the most recent glaciation involved confluent trunk glaciers which terminated near the head of the Inlet. Beyond this major terminus, smaller glaciers along the sides of the Inlet debouched into a high full-glacial sea. Initial retreat from the last glaciation is well documented by moraines, kame terraces, and ice contact-deltas.

The oldest date on the terminus of the last glaciation is 9845 BP. After this time, slow retreat was in progress so that some of the ice margins were within 7 km of their current position by ca. 9.7 ka BP. The mouths of the confluent valleys at the head of the Inlet did not become ice-free until ca. 8 ka BP. However, after ca. 8 ka BP glacial retreat accelerated greatly so that the entire lowland became ice-free within ca. 400 years.

Relative sea level curves concur with the ice load changes suggested by the pattern of recession from the maximum limit of the last glaciation. Distal to the ice limit the full glacial sea attained 124 m a.s.l.. The strandlines indicate that slow emergence occurred from 11-10.5 ka BP to ca. 8 ka BP (0.72 m 100 yr^{-1}). This period was followed suddenly by 'normal' rapid postglacial emergence which decelerated to the present.

The characteristic stratigraphy varies between the proximal and distal sides of the 10 ka BP ice margin. Up-ice of this margin, at the head of the Inlet, the sections commonly show that a marine transgression immediately followed the retreat of a grounded glacier. Conversely, distal to the 10 ka BP margin, along the sides of the Inlet, the stratigraphy shows complex intercalations of marine and glacigenic sediments indicating proximal ice front conditions throughout the whole of the sedimentary record where small valley glaciers contacted the full glacial sea.

The marine limit of the full glacial sea rises from 92 m a.s.l., at the outer coast, to 124 m a.s.l., near the last ice limit at the head of the Inlet. Emergence from this marine limit, on the distal side of the ice limit, occurred simultaneously along the sides of the Inlet. Conversely, the marine limit on the proximal side of the ice limit descends in the up-ice direction. In this area the age of the marine limit is directly controlled by the retreat of the ice front and is therefore progressively younger in the up-ice direction.

Individual strandlines tilt up in a southwesterly direction, towards the central Grant Land Mountains, suggesting a center of isostatic uplift in that area. Regional isobases on the 10 ka and 8 ka BP shorelines show this discrete center which is separated from the Greenland center by a cell of low emergence over the Lake Hazen area. The regional isobases indicate that by 6 ka BP the tilting of shorelines was dominated by the former Greenland ice load.

The history of emergence on northernmost Ellesmere Island is similar to that on northeastern Ellesmere Island and Greenland, but initial emergence occurs two thousand years sooner in Clements Markham Inlet. This may be due to: a dissimilar glacioclimatic regime influenced by the proximity of the Arctic Ocean; or due to a difference in the response times between the Greenland Ice Sheet and the Ellesmere Island ice caps.

2725 BÉLANGER, J.R., and KLASSEN, R.A. - 1983-1984
Les glaciers de l'île Bylot: une fenêtre sur le passé; *GEOS*, vol. 12, no. 4, pp. 10-13.

The processes associated with modern glaciers provide a key to the origins and properties of the glacial sediments of past ice ages. The numerous glaciers of Bylot Island provide an opportunity for the study of modern systems of alpine glaciers in a polar setting. They are fed from icefields among the central highlands and flow outward across adjacent lowlands as large tongues of ice. Satellite images show clearly the extent of ice on the island and the areas of annual snow accumulation and melt.

The near vertical margins of the ice tongues reveal a basal zone of sediment-rich ice overlain by dirt free glacier ice which forms the bulk of the glacier. Debris falling on the ice surface from valley walls is carried in rubble ridges along the glacier sides and in rubble stripes along the ice tongue. Terminal moraines are formed in front of glaciers during expansion periods. During and after deposition, debris carried by the ice can be eroded and redeposited by meltwater streams.

2726 BLASCO, S.M., HARPER, J.R., and FORBES, D.L. - 1985
Sediment distribution and dynamics in the southern Beaufort Sea; *in* Proc. Workshop on Arctic Regional Coastal Erosion and Sedimentation, Nov. 15-16, 1983, Calgary, Alta., Nat. Res. Council, Assoc. Com. Research on Shoreline Erosion and Sedimentation, pp. 1-2.

We summarise the distribution of surficial materials on the shelf and coast of the southern Beaufort Sea, using results of coastal mapping and a synthesis of high-resolution seismic reflection and borehole data. We also present a preliminary sediment budget and a review of the major sediment transport processes.

2727 BROPHY, J.A., GIBBINS, W.A., LAPORTE, P.J., LORD, C.C., PADGHAM, W.A., and SEATON, J.B. - 1983
Mineral Industry Report 1979, Northwest Territories; *Ind. & Northern Affairs*, Northern Affairs Program, Yellowknife, 283 p.

Le présent rapport traite de l'industrie d'exploitation et d'exploration minière aux Territories du Nord-Ouest (TNO) en 1979. Ce rapport a été rédigé par le personnel de la section de la géologie économique du Programme des Affaires du Nord, ministère des Affaires Indiennes et du Nord, à Yellowknife.

2654 BUKRY, D. - 1985
Correlation of Late Cretaceous Arctic silicoflagellates from Alpha Ridge; *Geol. Surv. Can.*, Paper 84-22, pp. 125-135. *CESAR Contr. No. 16.*

2728 CAMPBELL, F.H.A. - 1983
Stratigraphy of the Rae Group, Coronation Gulf area, Districts of Mackenzie and Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 83-1A, pp. 43-52.

The Hadrynian Rae Group of the Coronation Gulf area consists predominantly of a shallow-water succession of fine grained sandstones, siltstones, dolomites and

shales that accumulated in a broad, NNW-facing basin. Earlier correlations suggested that the group is equivalent to similar rocks in the Richardson Islands area of southern Victoria Island and in the Jameson Islands at the north end of Bathurst Inlet. The dolomite-dominated unit intercalated with the diabase sills, which makes up the bulk of the islands in Coronation Gulf, has been traced from the type area at the Rae River north of Coppermine to Victoria Island. A basal quartzite in the group, initially recognized in northern Bathurst Inlet has been traced westward into the lower part of the Rae Group, thus confirming the earlier interpretation of Rae sediments in the Bathurst Inlet region. Worm burrows, but more importantly trilobite tracks, in the uppermost two units of the initially-defined Rae Group demonstrate that these two units at least are Cambrian in age, and that a redefinition of the Rae Group is required.

Paleocurrent data from the underlying Husky Creek Formation of the Coppermine River Group suggest the formation was deposited in a generally southwest-trending valley during a pause(s) in extrusion of the partially coeval Copper Creek lavas.

2729 CHRISTIE, K.W., and FAHRIG, W.F. - 1983
Paleomagnetism of the Borden dykes of Baffin Island and its bearing on the Grenville Loop; *Can. J. Earth Sci.*, vol. 20, pp. 275-289.

Northern Baffin Island is intersected by spectacular swarms of predominantly northwesterly trending diabase dykes. Cross-cutting relationships, K-Ar ages, and paleomagnetic contact tests indicate that these dykes represent at least two major episodes of Hadrynian igneous activity. The Borden dykes were emplaced during the earlier of these episodes. They are about 950 Ma old and have a paleomagnetic pole position of 153.3°E, 26.7°S, $\delta m = 8.6°$, $\delta p = 6.1°$. The later episode saw the emplacement of the previously defined Franklin dykes, which are about 750 Ma old. The newly defined Borden pole lies at the southern extremity of the Grenville Loop and has an age consistent with poles of similar position that were derived from rocks of the Grenville Province.

All of the dykes probably reflect tension acting in an east-northeast - west-southwest direction. The directions of thick northwest trending dykes, which form a considerable angle to that expected from east-northeast tension, are thought to have been controlled by earlier (circa 1200 Ma) fractures of the Borden fault zones. The two main surges of magma may coincide with two periods of Hadrynian uplift in the Boothia Peninsula area to the west.

2730 CLARK, D.L., VINCENT, J-S, JONES, G.A., and MORRIS, W.A. - 1984
Correlation of marine and continental glacial and interglacial events, Arctic Ocean and Banks Island; *Nature*, vol. 311, no. 5982, pp. 147-149.

Correlation of Pleistocene glacial and interglacial sediments deposited on land with sediments deposited synchronously in the ocean basins is rarely accomplished. A significant exception is the correlation of continental shelf Bay of Biscay interglacial deposits with interglacial sediments from north-east France using $\delta^{18}O$ and pollen. In the Arctic Ocean, the definition of a partial magnetic stratigraphy for a Pleistocene sequence on Banks Island, western Arctic Archipelago, permits correlation with magnetically defined marine sediment of the Chukchi-Alpha Ridge. We report here the details of this first Arctic Ocean glacial-marine to continental-glacial deposit correlation, and its climatic interpretation. Arctic Ocean sediment texture is climatically controlled and fine-grained textured sediment was deposited in the ocean at the same time as interglacial deposits formed on the adjacent land. The occurrence of coarse-grained Arctic Ocean sediment on the other hand is synchronous with glacial advances on land and also represents periods of deglaciation.

2731 DAVIES, E.H. - 1983
The dinoflagellate oppel-zonation of the Jurassic-Lower Cretaceous sequence in the Sverdrup Basin, Arctic Canada; *Geol. Surv. Can.*, Bull. 359, 59 p.

Jurassic to Lower Cretaceous samples from the Sverdrup Basin, Arctic Canada, contain abundant and well preserved dinoflagellate cysts. The stratigraphic interval studied comprises the Savik-Formation - Jaeger Formation complex, the Awingak Formation - Ringnes Formation deltaic complex and the Deer Bay Formation - Mould Bay Formation deltaic complex; it is characterized by dominantly clastic sedimentation.

Seventeen dinoflagellate cyst Oppel-zones are recognized within the Lower Jurassic to Lower Cretaceous interval. The ages suggested by the assemblages of dinoflagellate cysts generally agree with those based on invertebrates and range from Toarcian or older to Late Valanginian or younger.

Sixty genera and 129 species of dinoflagellate cysts have been identified. Eighteen new species are described.

2732 DAWES, P.R., and FRISCH, T. - 1981
Geological reconnaissance of the Greenland Shield in Melville Bugt, North-West Greenland; *in* Report of Activities, 1980, Geol. Surv. Greenland, Report no. 105, pp. 18-26.

Geological reconnaissance mapping of the Thule - Melville Bugt region was completed in summer 1980 with the extension of the field work along the Lauge Koch Kyst in central and southern Melville Bugt. The work has concentrated in the region east of Kap Edvard Holm southwards down to Steenstrup Gletscher, the southern boundary of the 1:500 000 map sheet. The mapping was a continuation of the 1978 field work during which the area between Kap York and Fisher Øer was covered.

Melville Bugt is characterised by an extremely narrow and broken ice-free coast, being for the most part composed of nunataks, islands and small peninsulas. The Inland Ice reaches the coast in many broad glacier fronts, often with floating tongues, and in summer the coast usually has a high concentration of ice. Parts of the nunatak terrain approach 1000 m altitude, with the snow-covered Haffner Bjerg as the highest summit at 1462 m.

2573 DAWSON, M.R., and HICKEY, L.J. - 1984
Additional evidence on age disparity of High Arctic terrestrial biota during the Late Cretaceous and Early Tertiary; *Abstract in*, Can. Paleontology and Biostratigraphy Seminar, Ottawa, Sept. 28-30, 1984.

2733 DAWSON, M.R., WEST, R.M., and HICKEY, L.J. - 1984
Paleontological evidence relating to the distribution and paleoenvironments of the Eureka Sound and Beaufort Formations, northeastern Banks Island, Arctic Canada; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 359-361.

Recent discoveries of vertebrate, invertebrate and plant fossils near Nangmagvik Lake, northeastern Banks Island, N.W.T., confirm the presence of marine strata in the local Paleogene Eureka Sound Formation and indicate a wider distribution of the Neogene Beaufort Formation than previously believed.

2734 DYKE, A.S. - 1983
Quaternary geology of Somerset Island, District of Franklin; *Geol. Surv. Can.*, Memoir 404, 32 p.

Somerset Island was formed during a Late Cretaceous-Tertiary rifting episode associated with separation of Canada and Greenland. The Barrow Surface and anomalous canyons near the northeast coast are relict, pre-rifting landforms.

Surface materials are divided into eight genetic units. Rock and residuum cover 70 per cent of the island, till covers 20 per cent, and glaciofluvial, glaciolacustrine, fluvial, marine, and colluvial sediments cover the rest.

Gravel resources are small. Sand is more plentiful but is concentrated in a few large deposits. Riprap is widespread but thin.

Till and residual soils have low liquid limits and narrow ranges of plasticity. Massive ground ice is common in till more than 2 m thick. Thinner till and residual soils lack large bodies of massive ice, but natural moisture contents exceed liquid limits in the uppermost permafrost, especially at the till/rock interface. Marine and fluvial sediments have high ground ice contents in the upper 2 m or so of permafrost; natural moisture contents exceed the liquid limits of the silt and clay deposits. Slopes on till, residuum, colluvium, and on marine silt and clay are prone to instability during the spring snowmelt and active layer thaw period; instability could be induced later in the thaw season by wetting of slopes, thawing the upper ice-rich permafrost, or other active layer disturbances.

2735 DYKE, A.S., DREDGE, L.A., and VINCENT, J-S. - 1983-1984
Canada's last great ice sheet; *GEOS*, E.M.&R., vol. 12, no. 4, pp. 6-9.

Canadian and American scientists disagree strongly on ice sheet models. There are still many fundamental questions to be answered on both the Laurentide Ice Sheet and the peripheral ice masses. Was there or was there not a Hudson Dome? What was the style of glaciation in the Interior Plains? Was there an Innuitian Ice Sheet? Was there an Appalachian Ice Complex? Fortunately, with more discussion and field work in critical areas, we can strive for a better understanding of our glacial past.

2736 DYKE, A.S. - 1984
Quaternary geology of Boothia Peninsula and northern district of Keewatin, Central Canadian Arctic; *Geol. Surv. Can.*, Memoir 407, 26 p.

A surface of erosional planation, of regional extent in the central Canadian Arctic, was fragmented during the Eurekian Rifting Episode (Miocene-Pliocene) to produce the plateaus, plains, and lowlands of the study area and the rift valleys occupied by the large marine channels.

Seven genetic groups of materials - rock, till, and glaciofluvial, glaciolacustrine, glaciomarine, marine, and fluvial sediments - constitute the surface of the map area, but rock and till are predominant. The till sheet exhibits major lateral facies changes which define two large carbonate dispersal trains. Thick glaciomarine silt and clay extend in a wide belt across the southern part of the map area.

Aspects of possible future engineering concern include: scarcity of sand and gravel in much of the area, natural instability of most unconsolidated material on slopes, high ground-ice content of thick till and fine grained glaciomarine sediment, annual thermal contraction and cracking of soil, frost heaving of soil and bedrock, ice push at sea and lake shores, and ice scouring of river beds and banks.

Analyses of about 750 till samples provide the initial geochemical data base for this region. Variations in background levels of base metals reflect variations in carbonate content.

All surface sediments shown on Map 1570 A were deposited during the late Wisconsin glaciation. During the late Wisconsin maximum a major dome of the Laurentide Ice Sheet had a north-south oriented ice divide located over M'Clintock Channel. M'Clintock Dome was contiguous with the main body of the ice sheet to the south and coalesced with the Foxe Dome at the base of the Gulf of Boothia. M'Clintock Dome generated an eastward to east-northeastward flow over Boothia Peninsula and northern District of Keewatin. Important features of this flow regime were two large ice streams at the base of the ice sheet.

Deglaciation began more than 9250 years ago and initial retreat was westward, towards the centre of the M'Clintock Dome. Retreat swung gradually to the south as a calving bay along the western side of Somerset Island and Boothia Peninsula penetrated the central parts of the dome. Boothia Peninsula was largely ice free by 8800 years B.P. and the marine-based part of the M'Clintock Dome had completely disappeared by 8700 years ago. A moraine system of regional extent in Arctic Canada, locally named the Chantrey Moraine System, was deposited shortly after 8700 years B.P. and could reflect increased accumulation on the Laurentide Ice Sheet brought on by creation of a new moisture source when the sea invaded the region previously occupied by the northern part of the M'Clintock Dome.

Emergence during deglaciation exceeded 30 m per century, at least in places, and averaged more than 53 cm per century during the past 4500 years.

2737 EICHLER, H. - 1981
Rock temperatures and insolation weathering in the High Arctic, Oobloyah Bay, northern Ellesmere Island, N.W.T. Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 441-464.

Between June 25th and August 3rd, 1978 rock temperature measurements were executed in the expedition area at elevations up to 125 m a.s.l. This was accomplished in order to be able to estimate the importance of high arctic insolation relevant for weathering processes. During this time no zero degree transition could be recorded except for fluvioglacial gravel near the glacial margin of Carl Troll Glacier - but instead remarcably high surface maxima of rock temperatures up to 39, 7°C.

The constantly very low angle of sun radiation during all the high arctic summertime results in slopy terrain - especially in those parts exposed to the south - in areal shadow effects quite in contrast to the conditions in the plain. The consequence is an excessive thermic diurnal rhythm on shady "night slopes" and their block material resting on them.

For this reason it is proposed here to distinguish between arctic "slope" and "plain" regions when discussing microclimatological questions or even thermic controlled weathering processes.

Blocks of the arctic plain region do not show features of thermic strain being dependant on exposition because they are radiated more or less regularly the whole day round, however the blocks of an arctic slope region do show strain. In the latter case those sides of blocks which were enlighted only half a day long carry very strong weathering features especially where they are exposed to the south on south slopes.

Absence of frost, high daily amplitudes of surface temperatures (up to 20°C) as well as heavy thermic turbulence in the rock's interior being expressed by the lines of tautochrones, all these oblige to a change of mind - at least as far as the expedition area is concerned. Not the frost but the insolation appears to be the main agent of high arctic temperature weathering. Especially in the high North exposition and slope angle hardly ever were taken into account as controlling factors of high geo-ecological and morphodynamic rank. An application of high arctic weathering rules upon Pleistocene environments of our temperate zones following the actualistic principle should be dealt with upmost precaution.

2738 EICHLER, H. - 1981
Small scale features of high arctic weathering in the Oobloyah Bay region, northern Ellesmere Island, N.W.T. Canada - Genesis and processes; *in* Results of the Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 465-486.

From a wealth of small-scale features of high-arctic weathering certain phenomena of periglacial research will be discussed anew as they were overlooked or interpreted in another way. Tafone-like weathering forms are characteristic for south to south-west exposed blocks of Heiberg-sandstone in slope-areas. Flaking which is typical for the Heiberg-sandstone can be explained by the rock-corroding action of endolithic lichens.

Such flaking may bring out a retreat-rate of walls of rock of about 0.75 to 1.5 mm per year. For oricanga-like forms factors of zoogenic influence could be found (solubilizing effects of birds excrements). Frost-weathering during arctic summer is assumed as an exception and is explained by special orographic and meteorological conditions.

2739 ELLIOTT, D.K. - 1983
New Pteraspididae (Agnatha, Heterostraci), from the Lower Devonian of Northwest Territories, Canada; *J. Vertebrate Paleontology*, vol. 2, no. 4, pp. 389-406.

Three new genera of pteraspidids from Arctic Canada improve the known distribution of the family beyond Europe, Spitsbergen and eastern Canada where they have biostratigraphic value.

Stegobranchiaspis baringensis, *S. baringensis* var. *falcata*, *Unarkaspis schultzei* and *Escharaspis alata* from the Peel Sound, Drake Bay and Snowblind Bay formations of Prince of Wales and Cornwallis Islands, N.W.T., are medium-sized to large pteraspidids with distinctive proportions of probable adaptive significance. Faunas containing these pteraspidids provide a local correlation between the basal Snowblind Bay Formation and upper members of the Peel Sound and Drake Bay formations. Associated conodonts indicate a late Gedinnian to Siegenian age for the fauna, and comparison with successions elsewhere suggests an equivalence with the "vogti" horizon in Spitsbergen and the "crouchi" zone of the Anglo-Welsh succession.

2740 ELLIOTT, D.K., and DINELEY, D.L. - 1983
New species of *Protopteraspis* (Agnatha, Heterostraci) from the (?) Upper Silurian to Lower Devonian of Northwest Territories, Canada; *J. Paleontology*, vol. 57, no. 3, pp. 474-494.

The new species *Protopteraspis pygmaea*, *P. sartokia*, *P. siliktokia*, *P.* (?) *arctica* and *P.* (?) *corniga* from the lower member of the Peel Sound Formation of Prince of Wales and Somerset Islands, and Boothia Peninsula, Northwest Territories, Canada are small forms with generally blunt or broad rostra and have strong resemblances to previously known species from Europe, Spitsbergen and southern Canada. Associated heterostracans and conodonts indicate a Pridolian or Early Gedinnian age for the *Protopteraspis* horizons and suggest that this fauna is significantly older than *Protopteraspis* previously described from Europe, N. America and Spitsbergen. Thus there is evidence of an evolutionary center for this group in the Canadian arctic during late Silurian time.

2741 ELLIOTT, D.K. - 1984
A new subfamily of the Pteraspididae (Agnatha, Heterostraci) from the Upper Silurian and Lower Devonian of Arctic Canada; *Palaeontology*, vol. 27, part 1, pp. 169-197, pls. 22-24.

New Pteraspididae from the upper Silurian and lower Devonian of arctic Canada differ from established members of the family in possessing a single orbito-cornual plate and a pineal plate enclosed by the dorsal disc. A new subfamily of the Pteraspididae, the Anchipteraspidinae, is raised to accommodate five species of the new genera *Anchipteraspis*, *Ulutitaspis*, and *Rhachiaspis*. Consideration of the growth and structure of the shields of the Anchipteraspidinae indicates their close relationship to both the Cyathaspidinae and early members of the Pteraspidinae. It is proposed that the Pteraspididae were developed from the Cyathaspidinae by processes both of fusion and subdivision of the shield and that the Psammosteida developed from the Pteraspidinae by similar processes.

2742 EMBRY, A.F. - 1984
Stratigraphic subdivision of the Roche Point, Hoyle Bay and Barrow formations (Schei Point Group), western Sverdrup Basin, Arctic Islands; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 275-283.

In the western Sverdrup Basin the Roche Point, Hoyle Bay and Barrow formations (Schei Point Group, Middle-Upper Triassic) have been subdivided into formal members on the basis of subsurface stratigraphic analysis. Four members are recognized in the Roche Point Formation, and in ascending order are named Eldridge Bay (sandstone), Cape Caledonia (shale-siltstone), Chads Point (sandstone) and Gore Point (limestone, sandstone). The source area for the clastics of the lower three members lay to the south whereas the source for the Gore Point was to the north. The Hoyle Bay Formation is divided into two members: Eden Bay (shale, siltstone, limestone) and Cape Richards (shale, siltstone). The source area for these units was to the north. One member, the Jenness (sandstone, siltstone and shale) is recognized within the Barrow Formation, and its source area lay to the northwest.

2743 EMBRY, A.F. - 1984
The Wilkie Point Group (Lower-Upper Jurassic), Sverdrup Basin, Arctic Islands; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 299-308.

The Wilkie Point Formation, a Lower-Upper Jurassic sandstone-dominant unit in the Sverdrup Basin, is herein raised to group status. Four new formations are recognized within the group. These new formations are formally defined herein and, in ascending order are: Jameson Bay, Sandy Point, McConnell Island and Hiccles Cove. The Jameson Bay and McConnell Island formations comprise mainly shale and siltstone of offshore marine shelf origin. The Sandy Point and Hiccles Cove consist predominantly of very fine- to medium-grained sandstone of nearshore to strandplain origin.

The Jameson Bay Formation is divided into three members that are formally defined herein. In ascending order these members are named Intrepid Inlet, Cape Canning and Snowpatch.

2744 EMBRY, A.F. - 1984
The Schei Point and Blaa Mountain groups (Middle-Upper Triassic), Sverdrup Basin, Canadian Arctic Archipelago; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 327-336.

The Schei Point Formation, a Middle-Upper Triassic clastic unit in the Sverdrup Basin of Arctic Canada, is herein raised to group status, and five new formations are recognized within the group. These new formations are formally defined herein and, in ascending order, are: Murray Harbour, Roche Point, Hoyle Bay, Pat Bay and Barrow. The Roche Point and Pat Bay formations consist mainly of nearshore marine sandstones and are present only on the basin margins. The Murray Harbour, Hoyle Bay and Barrow formations consist of shale and siltstone of offshore shelf to slope origin, and these formations extend across the basin. Within the basin the Murray Harbour, Hoyle Bay and Barrow comprise strata formerly assigned to the Blaa Mountain Formation. Consequently the Blaa Mountain is also given group status.

2745 ENGLAND, J. - 1983
Isostatic adjustments in a full glacial sea; *Can. J. Earth Sci.*, vol. 20, no. 6, pp. 895-917.

During the last glaciation an ice-free corridor existed between the northeast Ellesmere Island and northwest Greenland ice sheets. This corridor constituted a peripheral depression in which the marine limit marks the uppermost extent of a full glacial sea. The full glacial sea is characterized by (1) ^{14}C dates on *in situ* marine shells that predate initial emergence (unloading) followed by (2) synchronous emergence from the marine limit throughout the peripheral depression. Relative sea-level curves from the full glacial sea confirm previous morphostratigraphic and glacioisostatic evidence for limited ice extent during the last glaciation. These curves also document the history of glacial unloading and the form of the relative sea-level curve that one would theoretically expect in the peripheral depression. The form of the curves presented here is unlike any other published emergence curves from arctic Canada or from Fennoscandia.

The relative sea-level curves for northeast Ellesmere Island show three segments: (1) an interval of stable relative sea level (isostatic equilibrium) at the marine limit between at least 11 000 and 8000 BP; (2) an interval of slow emergence from 8000 to 6200 BP during which northeast Ellesmere Island ice slowly retreated; and (3) an interval of rapid emergence, caused by rapid glacial unloading, after 6200 BP when a prominent amelioration was in progress. These relative sea-level curves are discussed in relation to other paleoclimatic changes and the deglacial history of northwest Greenland. These curves are of regional importance in that they provide a new means of distinguishing between areas that were ice covered and ice free during the last glaciation.

2746 FISCHER, B.F.G. - 1984
Stratigraphy and structural geology of the region surrounding Bunde and Bukken fiords, Axel Heiberg Island, Canadian Arctic; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 309-314.

The region surrounding Bunde and Bukken fiords on northwestern Axel Heiberg Island, in the Canadian Arctic Archipelago, is underlain by a thick (over 6000 m) succession of rocks, consisting primarily of sedimentary strata similar to those that exist elsewhere in the axial portion of the Sverdrup Basin. Included in this sequence are Cretaceous mafic volcanic flows, pyroclas-

tic units, and lithic clastic strata. Numerous sills and dykes, presumably related to the volcanic activity, cut and thicken the sedimentary package.

Compression during the early Tertiary Eurekan Orogeny gently deformed the strata. There was an extensional event prior to this orogeny, and the resultant normal faults produced a horst, which may have affected the development of the later structures. The orogeny itself is defined as a compressional phase and resulted in the formation of three large, steeply dipping, reverse faults. The faults have opposing dips and opposing directions of vergence, and are associated with a number of folds. Horizontal shortening associated with each of these faults is estimated to be in the order of 3 km. Typically, the Permian carbonates are juxtaposed over Triassic sandstones and shales. The zone of detachment for these faults lies within the evaporites of the Otto Fiord Formation. A single normal fault which crosscuts one of the major reverse faults in the study area may represent a third deformational period.

2747 FOLEY, S. - 1984
Petrofabric analysis of rock salt, Stolz diapir, eastern Axel Heiberg Island, Canadian Arctic; unpub. B.Sc. thesis, Dept. Geology, Univ. Toronto, 34 p.

Crystal orientations of halite were measured by means of a reflection goniometer of a design similar to that used by Alan Clark.

Petrofabric analysis of NaCl crystals from the Stolz diapir, eastern Axel Heiberg Island, Canadian Arctic reveals an axially symmetric orientation of ⟨100⟩ for a fine grained sample, and apparently random orientation for two other samples with bimodal grain sizes. Presumably, the Stolz diapir involved axisymmetric deformation about the vertical direction. This assumption was based on the presence of subvertical bedding in the exposed salt.

Sample 1 has been interpreted as a fabric similar to the dynamic recrystallization texture obtained experimentally. Both samples 2 and 3 seem to have experienced post-deformational recrystallization. Alternatively, they could represent recrystallized domains of markedly inhomogeneous deformation.

2748 FORBES, D.L. - 1981
Babbage River Delta and Lagoon: hydrology and sedimentology of an Arctic Estuarine System; unpub. Ph.D. thesis, Univ. British Columbia, 554 p.

Inputs, transfer processes, and storage characteristics of water and sediment have been investigated in a 40-km^2 estuarine system on the Yukon coast. The setting is transgressive, microtidal, and high-latitude (69°N). The system can be subdivided into fluvial, tidal-distributary, delta-plain, intertidal, lagoon, marginal-supratidal, and barrier subsystems, each associated with one or more distinctive depositional environments and characteristic lithofacies assemblages. The structure of the system has been examined in terms of links between subsystems and overall system response to input perturbations. Although the propagation of tide and surge within the estuary may be treated as a quasi-linear stochastic process, transfers of fluvial water and sediment through the system are highly non-linear.

Inputs and system responses are dominated in the short run by seasonal- and synoptic-scale variance, the former involving major adjustments in the phase distribution and circulation regime of the estuary. Rapid flushing of saline water from the system by snowmelt runoff constitutes a major periodic threshold; a second occurs when brackish water intrudes in mid-summer. Water level, storage volume, salinity, and suspended sediment sequences in the lagoon during the open-water season are dominated by wind effects; in the delta, the major synoptic-scale anomalies of suspended sediment concentration are related to storm runoff. Fluvial clastic sediment inputs to the estuary exceed 10^8 kg/a, almost an order of magnitude greater than the estimated littoral transport. More than 97% of the fluvial input may occur in June; approximately half may be exported directly from the system. Important ice effects include restriction of runoff and wave generation in winter, creation of hypersaline conditions, and control of the sedimentologically important flood events on deltaic supratidal surfaces.

At longer time scales, the estuarine system has been profoundly affected by transgression due to rising sea level and coastal erosion. A transgressive sequence has developed with numerous distinctive features attributable to the microtidal high-latitude setting. Examples of transgressive, progradational, and inlet-fill barrier sequences and of contrasting deltaic sequences occur in close proximity on the Yukon coast, reflecting different system input regimes or parameters. In a given system, the large-scale relationships between storage components of individual subsystems result from long-term non-stationarity of the input regime or changes in system parameters. The nature of the system during deposition of much of the sediment in storage at a given time is not open in general to resolution by monitoring programs of any practical duration; any attempt to assess the full range of variance in such a system must employ both direct and indirect measures.

2749 FORBES, D.L., and LEWIS, C.P. - 1983
Transgressive coastal sedimentation, Yukon Beaufort Sea; *Abstract in*, Geological Assoc. of Canada Program with Abstracts, vol. 8, p. A23.

Holocene sedimentation on the Yukon coast has been dominated by marine transgression, by rapid erosion of ice-rich Pleistocene sediments exposed in coastal cliffs, and by fluvial, storm-surge, storm-wave, and ice processes. Coastal sediment sinks include deltaic-estuarine systems, barrier-lagoon complexes, shallow shelf areas, and a deep inner-shelf basin. Components of the surficial transgressive sequence include transgressive-limit driftwood, distributary-channel, lacustrine, supratidal, intertidal, lagoon, tidal-inlet, barrier, shoreface, and inner-shelf facies. The stratigraphy of the low coastal barriers is controlled by various factors, including changing relative sea level, local sediment budget, and recession of coastal anchor points. Examples of prograded, transgressive, and inlet-fill barrier sequences occur in close proximity on the Yukon coast. Marine transgression was initiated in Herschel Basin when the -15m sill between Kay Point and Herschel Island was overtopped ca 6 ka B.P. The transgressive barrier sequence revealed by a borehole transect across

Kay Point Spit and Babbage Lagoon includes a 4-5 m sand-gravel barrier unit overlying fine-grained lagoon sediments. Supratidal and lagoon facies have been eliminated seaward of the spit by very rapid landward migration of the barrier relative to the rate of increase in local mean sea level. Franklin's 1826 data suggest that transgression of Kay Point spit may have reduced the area of the Babbage Estuary by 50% over the past 150 years and significantly altered the wave regime and sediment budget at nearby Spring River barrier, a prograded system.

2750 FORBES, D.L. - 1983
Morphology and sedimentology of a sinuous gravel-bed channel system: lower Babbage River, Yukon coastal plain, Canada; *Spec. Publs. int. Ass. Sediment*, vol. 6, pp. 195-206.

The lower Babbage River is a non-braided sinuous gravel-bed stream of the poorly documented class-5 meandering channel facies assemblage. It exhibits a low-Arctic nival runoff regime. The low-flow channel has a sinuosity of 1.89, a mean slope of 7.4×10^{-4}, mean width 62 m, mean maximum depth 1.36 m, and a variable width/depth ratio $24 \leq b/h_* \leq 226$. The sinuosity and mean width of the channel zone are respectively 1.3 and 222 m. The channel is dominated by lateral or point bars, diagonal bars, and a prominent pool-riffle sequence. The alluvial sediments are described using a modified version of the lithofacies classification proposed by Miall (1978). Imbricate gravel of lithofacies Gm ($12 < d_{50} < 20$ mm) forms an armour layer on channel-floor and bar-top surfaces. Bar-body deposits of sandy gravel ($6 < d_{50} < 12$ mm) include planar cross-stratified gravel (Gp) and massive or crudely stratified units (Gm). Bar-top sediments include gravel sheets and armour surfaces (Gm), shallow scours (Ge), and scour fills or veneers of sand and mud. Trough cross-stratified scour- or channel-fill gravels (Gt) are plausible but unconfirmed additions to the lithofacies set. Parallel-ridge gravels (Gr) are found only in reaches subject to overflow icing. Bar-tail sediments include planar cross-stratified gravels (Gp) and planar, trough and ripple cross-stratified sands (Sp, St, Sr). Channel-zone gravel bodies may exhibit planar bases and convex tops, with total width of 100-200 m and maximum thickness greater than 3 m. Overbank sediments, including peat (C), ice (I), stratified silts and sands (Fl and Sh; $0.01 < d_{50} < 0.3$ mm), and organic muds (Fsc), may exceed 8 m in thickness and cover a much greater area than any of the channel facies in the lower valley.

2655 FORSYTH, D.A., and WEBER, J.R. - 1985
Crustal structure of the central Arctic Ocean Basin: Seismic and gravity interpretation of the Lomonosov and Alpha ridges; *Abstract in* Inter. Workshop on Density Distribution of the Lithosphere, Inst. Geodesy & Photogrammetry, ETH, Zurich, Rep. No. 102, p. 19.

2751 FRENCH, H.M., and HARRY, D.G. - 1983
Ground Ice Conditions and Thaw Lakes, Sachs River Lowlands, Banks Island, Canada; *in* Mesoformen des Reliefs im heutigen Periglazialraum, Bericht über eim Sym., Abhandlungen der Akademie der Wissenschaften in Göttingen Mathematisch-Physikalische Klasse, Dritte Folge Nr. 35, pp. 70-81.

This paper describes, therefore, the relationship between lithology, permafrost conditions and thaw lakes in the Sachs River lowlands of southwest Banks Island. In this area, rapid coastal retreat of ice-rich unconsolidated sediments has led to the truncation and drainage of thaw lakes. This enables stratigraphic study of the sediments beneath basins and permits deductions as to the age and mechanism of formed lakes.

2752 FRISCH, T. - 1981
Comparative note on the Precambrian basement of southern Inglefield Land and eastern Ellesmere Island; *in* Report of Activities, 1980; Geol. Surv. Greenland, Report No. 105, pp. 14-18.

A one-week visit to southern Inglefield Land, by the GGU motor cutter *K.J.V. Steenstrup* in conjunction with P.R. Dawes' geological studies in North-West Greenland, provided an opportunity to examine the Precambrian crystalline basement between Sunrise Pynt and Kap Alexander. The basement exposures face those on eastern Ellesmere Island, no more than 70 km away across Smith Sound, which were mapped by the writer in 1977 for the Geological Survey of Canada. This note briefly compares the two areas.

2753 FUJINO, K., HORIGUCHI, K., SHINBORI, M., and KATO, K. - 1983
Analysis and characteristics of cores from a massive ice body in Mackenzie Delta, N.W.T., Canada; *in* Proc. Fourth Inter. Conf. on Permafrost, Nat. Academy Press, Washington, D.C., pp. 316-321.

Distinctive ground features such as polygons, pingos and involuted hills are commonly observed in the arctic regions. Their origins and formation processes remain in question. A massive ice body at Tuktoyaktuk was analyzed to determine its origin. Stratigraphic studies of fabrics, chemical components such as oxygen isotopes, conductivity and pH of core samples of the massive ice body, were investigated.

The results obtained suggest that most parts of the massive ice body originate from superimposed ice by congelation of water in which a snow pack is submerged, and do not support the hypothesis that it is segregated ice. The mechanism of the growth of a massive ice body is also not identical to that of the growth of a pingo in which segregated ice constitues the core.

2754 GIBBINS, W.A. - 1983
Mississippi Valley type lead-zinc districts of Northern Canada; *in* Proc. Inter. Conf. on Mississippi Valley Type Lead Zinc Deposits, Univ. Missouri-Rolla, Rolla, Missouri, pp. 403-414.

Mississippi Valley type (MVT) deposits account for all the lead, zinc, cadmium and a significant amount of the silver currently produced in Northern Canada. This production comes from deposits associated with a Middle Devonian barrier reef complex of the Pine Point District, the Polaris deposit in Ordovician Thumb Mountain Formation in the Cornwallis Lead-Zinc District and the Nani-

sivik deposit in Helikian (Proterozoic) Society Cliffs Formation on Northwestern Baffin Island. The Cordillera of Northern Canada contains important undeveloped MVT deposits in the Robb Lake, Gayna River, Bonnett Plume River and Godlin Lakes districts.

These deposits can all be related to major structural elements, (basement structures and/or unconformities) extensive shale source rocks and solution breccia or karst development. Hydrocarbons, evaporites and dolomitization are generally present, but have variable aspects.

Future exploration successes are most likely in known districts and extensions of these districts. IP, EM, gravity and geochemistry ("zinc-zap") have been successful exploration techniques in the Pine Point, Nanisivik, Cornwallis and Mackenzie Mountain areas respectively. Other areas with geological potential, but very little exploration to date, are the carbonates of the Franklin Miogeosyncline (Ellesmere Island), the Northern Interior Plains and the Clyde River Fold Belt of the Central Baffin Island. Potential for MVT deposits is more uncertain in carbonates of the Arctic Platform (Brodeur Peninsula of Northwestern Baffin Island and Victoria and Banks Islands of the western Arctic) and cratonic basins, the Foxe Basin and in the Northern Hudson Bay Basin (southern and western Southampton Island).

2755 HARDY ASSOCIATES (1978) LTD. - 1983
Surficial geology of the Illisarvik Area, Richards Island, N.W.T.; *Geol. Surv. Can.*, Open File No. 941, GSC List 914.

This Open File comprises a report (55 p.) on the surficial geology of the area around Illisarvik, Richards Island, N.W.T., which includes a 1:25 000 scale map and cross-sections; and a report (115 p.) on a geotechnical drilling program undertaken during the winter of 1982-83. The work, prepared under contract, was done in support of ongoing experiments related to the growth and development of permafrost.

2756 HARRY, D.G., FRENCH, H.M., and CLARK, M.J. - 1983
Coastal conditions and processes, Sachs Harbour, Banks Island, Western Canadian Arctic; *Z. Geomorph. N.F.*, Suppl.-Bd. 47, pp. 1-26.

The coastal environment of southwest Banks Island is intermediate between pack ice-dominated High Arctic and southern storm wave environments. Rates and patterns of shoreline evolution are strongly influenced by the presence of permafrost, the duration of open water conditions, and the magnitude and frequency of onshore storm events. Actively eroding sea cliffs follow an annual morphological cycle. Cliff failure mechanisms are frequently controlled by the quantity and distribution of ground ice. During the period 1950-1979, coastal retreat at some localities exceeded 2.0 $m \cdot yr^{-1}$. Mobilized sediment is transported by littoral drift to form constructional shoreline features including spits and offshore bars. Evidence suggests that, between 1950 and 1979, two spits near Sachs Harbour prograded by 400 m and 600 m respectively. The assumption that sediment transport along arctic coasts is a storm-dominated process appears justified in the present study.

2757 HARRY, D.G., and FRENCH, H.M. - 1983
The orientation and evolution of thaw lakes, southwest Banks Island, Canadian Arctic; *in* Fourth Inter. Conf. on Permafrost, Nat. Academy Press, Washington, D.C., pp. 456-461.

On southwest Banks Island, the melt-out of ice within unconsolidated permafrost sediments has resulted in the formation of numerous thaw lakes. A majority of basins are oriented perpendicular to prevailing winds and possess a D-shaped outline which is in equilibrium with wind-generated geomorphic processes. In particular, a strong relationship exists between lake morphology and the storm wind regime during the summer period of open water conditions. Thaw lakes in this area cannot be interpreted within the traditional "thaw lake cycle" and appear to represent quasi-equilibrium landforms. Shoreline erosion results in asymmetrical expansion rather than a lateral migration of the basin. Lake drainage occurs primarily by catastrophic outflow, following basin capture or truncation by coastal retreat.

2758 HEGINBOTTOM, J.A. - 1984
The bursting of a snow dam, Tingmisut Lake, Melville Island, Northwest Territories; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 187-192.

In July 1979 snowmelt from the hills surrounding Tingmisut Lake, Melville Island, accumulated in the lake basin, trapped behind a dense snowdrift which blocked the valley of the outlet stream. The water level rose until it overtopped this snow dam, and the flowing water cut down rapidly through the dam, resulting in a major flood event downstream. An estimated 1.6×10^6 m^3 of water drained from the lake in 36 hours. The implications of such events are discussed.

2759 HEGINBOTTOM, J.A. - 1984
Continued headwall retreat of a retrogressive thaw flow slide, eastern Melville Island, Northwest Territories; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 363-365.

The mean rate of headwall retreat of a retrogressive thaw flow slide near Tingmisut Lake, eastern Melville Island, decreased each year from 57 cm/100 h (1977) to 29 cm/100 h (1978), 28 cm/100 h (1979), to practically nil in 1981. By 1982 the headwall was reduced to a rubbly slope. Both the mean and maximum amounts of retreat correlate well with the thawing index, in Celsius degree-days, from Rea Point ($r = 0.73$ and 0.94, respectively).

2760 HÉLIE, R.G., and ELSON, J.A. - 1984
Discrimination between glaciogenic and weathering residue diamictons, Somerset Island, Northwest Territories; *in* Current Research, Part A, Geol. Surv. Can., Paper 84-1A, pp. 339-344.

On Somerset Island and in adjacent Arctic Canada it is difficult to distinguish between diamictons resulting from prolonged weathering of the rocks and those formed by glaciers. Grain size distribution parameters, including mean size, sorting, skewness, and kurtosis, have limited value for discriminating between these diamictons. Regression of sorting on mean grain size of about 15 samples of each type of diamicton distinguished some tills from weathering residues derived from crystalline

rocks, but did not do so for sedimentary or mixed source rocks. Analyses of quartz grain surface features using scanning electron microscopy proved to be impractical. X-ray diffraction diagrams of the clay-size fractions show peaks for quartz, mica, and chlorite in tills whereas the peaks in weathering residues are poorly defined or absent. Diffraction diagrams are diagnostic for all of the five till samples analyzed and four of five weathering residues.

2761 HÉLIE, R.G. - 1985
Surficial geology, King William Island and Adelaide Peninsula, Districts of Keewatin and Franklin; *Geol. Surv. Can.*, GSC List No. 933, Map 1618A, Scale 1:250 000.

2762 HICKEY, L.J., WEST, R.M., DAWSON, M.R., and CHOI, D. - 1983
Paleomagnetic and biostratigraphic correlation of the Eureka Sound Formation, Canadian Arctic Islands; *Abstract in*, Geol. Soc. America, Abstracts with Programs, vol. 15, no. 4, p. 219.

On the chart at right we present a recalibrated magnetostratigraphic profile of the late Cretaceous to early Tertiary Eureka Sound Formation on Axel Heiberg and Ellesmere Islands in the Canadian Arctic. This was accomplished using the following parameters: 1. Normal 24 was recognized based on its interrupted pattern and concurrence with vertebrates of Eocene age; 2. The base of Normal 25 was correlated with the base of the Clarkforkian Provincial Stage as in its type area in Wyoming and Montana; 3. The base of the section was fixed by reference to long Normal 33 and by the occurrence of late Santonian to early Campanian mollusks in Member 1 of the Eureka Sound Formation.

This allowed correlation of the Eureka Sound Formation and its fossil vertebrates, megaflora, and pollen zones to mid-latitude correlatives.

2763 HICKEY, L.J., WEST, R.M., DAWSON, M.R., and CHOI, D. - 1983
Arctic terrestrial biota: paleomagnetic evidence for age disparity with mid-latitude occurrences during the Late Cretaceous and Early Tertiary; *Abstract in*, Geol. Soc. America, Abstracts with Programs, vol. 15, no. 4, p. 249.

Revision of a magnetostratigraphic profile for the Late Cretaceous to Early Tertiary Eureka Sound Formation on Axel Heiberg and Ellesmere Islands in the Canadian Arctic has permitted correlation of the formation's units and fossils with both absolute and standard relative age schemes. This correlation reveals a profound disparity in the time of appearance of numerous taxa of terrestrial plant and vertebrate fossils in the Arctic as compared to mid-northern latitudes. The flora typical of the latest Cretaceous at mid-latitudes (Zone I), including such forms as *Aquilapollenites*, *Wodehousia*, and *Azonia* was replaced by one of Early Paleocene (Zone II) aspect in the early Campanian, some 15 million years earlier than in the south. By the Eocene, Arctic floras were back in phase with their mid-latitude counterparts.

Among vertebrates, typical Wasatchian and Bridgerian forms such as plagiomenids, tortoises, *Lambdotherium*, *Hydrachyus*, and *Pantolestes* occur just above Normal 25. This correlates with the base of the Clarkforkian Provincial Stage in its type area in Wyoming and represents a 2 to 4 million year offset in their time of occurrence.

These data indicate a profound heterochroneity of the Arctic terrestrial biota in the Late Cretaceous and Early Tertiary, and a probable Arctic origin for many taxa such as perissodactyls, *Pistillipollenites macgregorii*, and *Metasequoia occidentalis* that appear later at mid-latitudes without apparent precursors. This suggests that extreme caution must be exercised in extending the temporal connotations of pollen zones or so-called land mammal "ages" to the Arctic.

2764 HICKEY, L.J., WEST, R.M., DAWSON, M.R., and CHOI, D.K. - 1983
Arctic Terrestrial Biota: Paleomagnetic Evidence of Age Disparity with Mid-Northern Latitudes During the Late Cretaceous and Early Tertiary; *Science*, vol. 221, pp. 1153-1156.

Magnetostratigraphic correlation of the Eureka Sound Formation in the Canadian high Arctic reveals profound difference between the time of appearance of fossil land plants and vertebrates in the Arctic and in mid-northern latitudes. Latest Cretaceous plant fossils in the Arctic predate mid-latitude occurrences by as much as 18 million years, while typical Eocene vertebrate fossils appear some 2 to 4 million years early.

2765 HODGSON, D.A., VINCENT, J.-S., and FYLES, J.G. - 1984
Quaternary geology of central Melville Island, Northwest Territories; *Geol. Surv. Can.*, Paper 83-16, 25 p.

Moderately to completely weathered Devonian clastic rocks cover much of central Melville Island, including Dundas Peninsula. The principal Quaternary deposits are till and ice contact gravels, which occur in central and southeastern Dundas Peninsula. Deltaic and marine nearshore and beach sediments are scattered along lowland coasts.

Continental ice sheets, dispersing from the south, reached their maximum limits on central Melville Island during at least three episodes; only the age of the last advance has been determined. The oldest and most extensive glaciation recognized covered at least southern Dundas Peninsula up to 300 m a.s.l. and deposited Dundas Till plus a major belt of ice contact deposits. During a subsequent glaciation, ice from Parry Channel overlapped the south-central coast of Dundas Peninsula up to 100 m a.s.l. and deposited Bolduc Till. This deposition may have occurred at the same time that ice entered Liddon Gulf from the south, depositing Liddon Till to 100 m a.s.l. on the outer gulf coast.

At 11 700 ± 100 BP, all coasts were rising after crustal depression by ice assumed to have occupied Parry Channel and possibly covered the central Queen Elizabeth Islands. Maximum emergence on the south coast is at least 90 m; on all coasts farther north a prominent (and highest) water plane is recorded at about 55 m a.s.l. Subsequent to this initial emergence, ice from

Parry Channel readvanced over, and retreated from, the south coast of Dundas Peninsula probably between 10 340 ± 150 and 9670 ± 150 BP, depositing Winter Harbour Till up to 120 m a.s.l. Because shoreline emergence was not significantly interrupted by this readvance, it is concluded that offshore this ice sheet was probably floating. Local ice caps existed at undetermined times on the uplands of Melville Island, north of Dundas Peninsula.

2766 HODGSON, D.A., and VINCENT, J.-S. - 1984
A 10,000 yr B.P. Extensive Ice Shelf over Viscount Melville Sound, Arctic Canada; *Quaternary Research*, vol. 22, no. 1, pp. 18-30.

Late Wisconsinan age glacial landforms and deposits indicate that an ice shelf at least 60,000 km^2 flowed northwestward into Viscount Melville Sound, probably from the M'Clintock Dome of the Laurentide Ice Sheet. The ice shelf overlapped coastal areas and laid Winter Harbour Till up to 125 m above present sea level on the southern coast of Melville Island, to 135 m on Byam Martin Island, to possibly 90 m on the northeast tip of Banks Island, and to 150 m on the north coast of Victoria Island. The contemporary sea level was 50 to 100 m higher than present (it now rises eastward). A maximum age of 10,340 ± 150 yr B.P. for the till, and thus the ice-shelf advance, is provided by shells in marine sediments which underlie it, whereas a minimum age of 9880 ± 150 yr B.P. is provided by overlying shells that postdate the ice advance. The major advance of shelf ice into Viscount Melville Sound may be the result of the rapid disintegration of the M'Clintock Dome while the climate ameliorated in the western Arctic.

2767 HORN, D.R. - 1963
Submarine physiography and its bearing on Late Cenozoic history of the Canadian Arctic Archipelago; unpub. report, Geology 394.3, Univ. Texas, 25 p.

Submarine physiography of the interisland channels and adjacent areas of the continental shelf indicates that glacial scour of an older drainage system is the mode of origin of the sea-floor topography.,

2768 HUGON, H. - 1983
Ellesmere-Greenland Fold Belt: structural evidence for left-lateral shearing; *Tectonophysics*, vol. 100, pp. 215-225.

Regardless of whether they were passive or active markers of the Eurekan deformation, fold-axial traces in the Ellesmere-Greenland fold belt define a regional pattern typical of left-lateral ductile shear zones. It is therefore postulated that a left-lateral mega-shear zone spanned the entire east-west width of Ellesmere Island plus adjacent northern Greenland, and that the shear direction was subparallel to Nares Strait.

A left-lateral motion along Nares Strait is required by the plate tectonic models of J.T. Wilson and E.C. Bullard. To explain the opening of the Labrador Sea and Baffin Bay by sea-floor spreading, these models involve a left-lateral displacement between Greenland and North America of 200-400 km. Because of the lack of lithological and structural offsets across Nares Strait, the models have been controversial. The mega-shear zone proposed herein reconciles all the conflicting evidence. Accordingly, the ductile behaviour of the sedimentary strata on Ellesmere Island permitted a large left-lateral displacement of Greenland relative to North America without a large offset of geological features across Nares Strait.

2769 HUNTER, J.A. - 1980
Drained lake experiments for investigation of the growth of permafrost in the western Arctic; A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., ed. J.A. Hunter, 140 p.

This document was prepared at the request of the Permafrost Subcommittee of the Associated Committee in Geotechnical Research at their 18th meeting in Quebec City, September 27, 1979, for presentation at their 19th meeting in Winnipeg, January 11, 1980.

The Permafrost Subcommittee has endorsed the project and directed that a working committee be established to coordinate future research at these sites and to report annually to the Subcommittee; at least one member of the Subcommittee will sit on the working group.

2770 IRVING, E., and SWEENEY, J.F. - 1982
Origin of the Arctic Basin; *Transactions Royal Soc. of Can.*, Series IV, vol. XX, pp. 409-416.

In 1978 we produced a series of maps depicting the tectonic evolution of the Arctic from the Devonian to the Present based mainly on palaeomagnetic data available up to 1975. In this paper we present an updated series of maps for Late Jurassic onwards which incorporate palaeomagnetic data up to 1980 and which show the Arctic Basin not as static but as actively evolving during the Mesozoic and Cenozoic.

2657 JACKSON, R., and MUDIE, P. - 1984
CESAR cores: geological time capsules; *GEOS*, EM&R, vol. 13, no. 2, pp. 15-18. *CESAR Contr. No. 1.*

2658 JACKSON, H.R., FORSYTH, D.A., MUDIE, P., and AMOS, C. - 1984
Constraints on the tectonic origin of the Alpha Ridge; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, pp. 87-88.

2771 JEFFRIES, M.O., KROUSE, H.R., SHAKUR, M.A., and HARRIS, S.A. - 1984
Isotope geochemistry of stratified Lake "A", Ellesmere Island, N.W.T., Canada; *Can. J. Earth Sci.*, vol. 21, pp. 1008-1017.

Ionic composition, salinity, temperature, pH, tritium, and stable isotope compositions of water and ions were determined for samples collected in 1969 and 1982 from different depths of stratified Lake "A" on Ellesmere Island. Tritium contents and ionic and stable isotope compositions were diagnostic of recent fresh water overlying older, deeper trapped seawater. A temperature

maximum occurs at 15 m in the freshwater - seawater transition zone. Salinity, $\delta^{18}O$, and δD data suggest that the lake evaporated slightly and acquired about 12% freshwater prior to stratification. Individual ion concentrations reveal a slightly modified cation composition and marked depletions in sulphate and enrichments in dissolved carbonate compared with modern ocean water. The $\delta^{34}S$, $\delta^{18}O$, and $\delta^{13}C$ data for SO_4^{2-} and HCO_3^- attest to extensive anaerobic SO_4^{2-} reduction during the lake's history.

2772 JEFFRIES, M.O., KROUSE, H.R., SHAKUR, M.A., and HARRIS, S.A. - 1985
Isotope geochemistry of stratified Lake "A", Ellesmere Island, N.W.T., Canada: Reply; *Can. J. Earth Sci.*, vol. 22, pp. 648-649.

2660 JODREY, F., and HEFFLER, D. - 1985
Piston coring on CESAR; *Geol. Surv. Can.* Paper 84-22, pp. 175-177. *CESAR Contr. No. 19.*

2773 JONES, B., and NARBONNE, G.M. - 1984
Environmental controls on the distribution of *Atrypoidea* species in Upper Silurian strata of arctic Canada; *Can. J. Earth Sci.*, vol. 21, no. 2, pp. 131-144.

Evidence from numerous localities throughout the Upper Silurian strata of arctic Canada suggests that the ranges of the various species of *Atrypoidea* were controlled primarily by environmental factors. *Atrypoidea bioherma* n.sp. occurred only on and immediately around bioherms. *Atrypoidea foxi* inhabited subtidal areas in an offshore position and especially those areas between the bioherms with which *A. bioherma* were associated. *Atrypoidea phoca* apparently lived in a shallow subtidal area in close proximity to the shoreline. *Atrypoidea erebus* inhabited environments ranging from the low intertidal to shallow subtidal. *Atrypoidea netserki* lived in a shallow subtidal environment close to shore.

Fluctuations in bathymetry and other environmental parameters during the deposition of the Upper Silurian strata resulted in an apparent zonation of *Atrypoidea* species. These zones, however, are ecologically controlled and can therefore only be utilized for biostratigraphic purposes with the utmost care.

2774 KING, L. - 1981
Studies in glacial history of the area between Oobloyah Bay and Esayoo Bay, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 233-267.

Erratics found at about 600 m a.s.l. give the evidence for a very extensive glacierization during the Quaternary. Strong glaciation during early Wisconsin times is possible but could not be proved by own investigations. The deeply entrenched fiord systems are certainly of glacial origin, but must have been formed during earlier glaciations. It could be proved, that Webber Glacier shows a larger size today than 35000 years ago and a strongly reduced glacierization is assumed between 45000 (?) and 35000 years BP.

2775 KING, L. - 1983
Contribution to the glacial history of the Borup Fiord area, northern Ellesmere Island, N.W.T., Canada; *in* Late- and postglacial oscillations of glaciers: glacial and periglacial forms, Ed. H. Schroeder-Lanz, Univ. Trier, A.A. Balkema, Rotterdam, pp. 305-323.

The area selected for the expedition shows well preserved glacial relicts, raised deltas, and numerous glaciers of very different types. Methods for dating glacier fluctuations are being compared with those applied in the Alps. Glacial isostatic rebound favours research and amounts to 80 m in postglacial times. The relicts of the stages III and IV can be correlated with the "Baffinland Drift" of Andrews & Ives (1978). A minimum age of 6000 years BP for stage IV is obtained. Moraines of fluctuations after the climatic optimum exist at numerous other glaciers. Today the snout of Carl Troll-Glacier ends behind a prominent push moraine and shows a larger extent than at anytime during the last 4000 years. The tongue of Webber Glacier spreads over areas that were not occupied by glaciers for more than 5100 years. A very restricted extent for this glacier may be assumed about 35 000 years ago. The glacierizations responsible for the formation of the well developed fiord systems of Ellesmere Island must have been much more extensive. Erratics have been found at 600 m a.s.l. and originate from glaciations that are significantly earlier than the Wisconsin. Some postglacial fluctuations may be correlated with those known from the Alps.

2776 KLASSEN, R.A. - 1982
Quaternary stratigraphy and glacial history of Bylot Island, N.W.T., Canada; unpub. Ph.D. thesis, Univ. Illinois, 163 p.

This thesis is a study of the glacial history and Quaternary stratigraphy of Bylot Island, and it is the first comprehensive study of that island. The objectives of the study were to: 1) determine the extent of former cover by glaciers during different glacial events, 2) determine the source areas of those glaciers with regard to whether they formed on and moved outwards from the island (native ice) or originated from ice centres elsewhere in the arctic regions and moved onto the island (foreign ice), 3) estimate the timing of glacial events, and 4) develop an outline of both glacial and post-glacial history, particularly with regard to the character of interaction between native and foreign ice masses.

Lithologies of erratic clasts form the principal basis for the determination of foreign glacial events on Bylot Island, and of the main ice transport directions. Some erratic rock types do not occur as bedrock on the island, and they unequivocally demonstrate movement of glacier ice onto the island out of the surrounding channels. Amino acid ratios were used to establish correlations among deposits and their relative ages.

2777 KURFURST, P.J., MORAN, K., and NIXON, F.M. - 1984
Drilling and sampling in frozen seabottom sediments, southern Beaufort Sea; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 193-195.

Various drilling and sampling equipment, using different techniques, has been employed to drill and collect mar-

ginally frozen samples of seafloor sediments. Different types of corers and samplers are described and their performance is evaluated.

2778 LAPOINTE, P., and DANKERS, P. - 1982-1983
Equatorial Arctic yielding secrets; *Resource Develop.*, vol. 14, no. 5&6, pp. 4-6.

A wide sampling program of Siluro-Devonian sedimentary sections from the Arctic Archipelago has for the last three years been applying the technique of paleomagnetism. The results show that these rocks were deposited in an equatorial climate. These findings assist in an understanding of the Arctic's mineral potential.

2779 LAWRENCE, M., PELLETIER, B.R., and LACHO, G. - 1984
Sediment sampling of beaches along the Mackenzie Delta and Tuktoyaktuk Peninsula, Beaufort Sea; *in* Current Research, Part A, Geol. Surv. Can., Paper 84-1A, pp. 633-640.

Sixteen representative beaches along the southeastern Beaufort Sea are described and illustrated from the standpoint of morphology, erosion, and sediment transport. This is part of a larger fisheries research program (Department of Fisheries and Oceans) which is designed to gain information on the sensitivity of these beaches to erosion and oil contamination. Detailed textural analysis on 46 beach samples reveals the undercutting action of waves on shore cliffs that are undergoing thermal degradation and slumping. Fine sediment is removed by the waves and transported easterly by oceanic longshore currents towards Amundsen Gulf or to local sediment sinks lying east or west of the beach source. A strong beach armour of coarse pebbles, cobbles, and a few boulders characterizes most beaches on the mainland. Beaches on the barrier islands are mainly sand. Removal of beach armour should be prevented, and finer granular material should be removed with utmost precaution, particularly in those areas where replenishment is slow or perhaps where the loss cannot be replaced by wave action or longshore currents.

2780 LEWKOWICZ, A.G., AND FRENCH, H.M. - 1982
The hydrology of small runoff plots in an area of continuous permafrost, Banks Island, N.W.T.; *in* Proc. 4th Can. Permafrost Conf., March 2-6, 1981, Calgary, Alta., Nat. Res. Council, The Roger J.E. Brown Memorial Volume, pp. 151-162.

Hydrologic studies of four small runoff plots were conducted in the continuous permafrost zone of north-central Banks Island between 1977 and 1979. One plot was located on an interfluve while the other three were on slopes where snowbanks develop. The plots ranged in size from 27 to 525 m^2. For two or three months of each summer field season, all the major inputs and outputs of the hydrologic cycle were measured at each plot.

The results of the study indicate a high degree of variability in the proportions of water losses from the plots, attributable to surface and subsurface flow. This variability is evident both in inter-year comparisons for a single site and inter-site comparisons for a single year. Inter-year variability is controlled largely by the winter snow distribution and by meteorological conditions during the melt season. Inter-site variability is influenced by snowbank size, with the largest snow accumulation site exhibiting the highest percentage loss to surface flow, and the smallest loss to subsurface flow and evapotranspiration.

Surface-flow hydrographs of snowmelt runoff recorded at the plots are explicable within the context of accepted snowmelt theory. Surface flow generated by rainfall was much less important and occurred only twice in the three years of measurement. On these occasions, only areas downslope of existing snowbanks, or those areas from which snow had recently disappeared, produced surface flow. These observations support the validity of the partial and variable concepts of runoff generation in the high Arctic. Areas producing surface flow are dependent on topographically controlled snowbank distribution, rather than, as in temperate areas, on the location of streams.

2781 LEWKOWICZ, A.G., and FRENCH, H.M. - 1982
Downslope water movement and solute concentrations within the active layer, Banks Island, N.W.T.; *in* Proc. 4th Can. Permafrost Conf., March 2-6, 1981, Calgary, Alta., Nat. Res. Council, The Roger J.E. Brown Memorial Volume, pp. 163-172.

Subsurface water movement and solute concentrations were measured during the summers of 1977, 1978, and 1979 on two slopes with small runoff plots, located in the vicinity of the Thomsen River, north-central Banks Island. At two other instrumented plots, subsurface-flow volumes were estimated from water-balance studies.

The results show that the relative importance of subsurface flow in the water balance of individual plots varied both at daily and seasonal time scales. On all slopes, however, snowmelt was the major source of water supply, and flow declined very rapidly after the end of snow ablation.

In general, the values of solute concentrations in subsurface wash were high. Concentrations tended to increase with depth within the active layer. Seasonal trends in concentrations at any one depth included relatively low values during most of the snowmelt period, an increase in the ten days that followed, and a "plateau" concentration attained at very low discharges.

The total weights of solutes removed from the plots by subsurface flow during the snowmelt season were large, with a maximum of 43 g/m^2 in 1978 at the site of the largest snowbank. Using a dry bulk density of 1.5 Mg/m^3, this figure corresponds to a denudation rate of 29 mm/1000 years. The removal of materials in solution by subsurface flow is thus regarded as an important geomorphological process in this area of the Arctic.

2782 LEWKOWICZ, A.G. - 1983
Erosion by overland flow, central Banks Island, western Canadian Arctic; *in* Proc. 4th Intern. Conf. on Permafrost, Nat. Academy Press, Washington, pp. 701-706.

Process studies carried out at runoff plots on Banks Island emphasize the importance of solute erosion by overland flow, rather than suspended sediment removal. Rates are low, despite the influence of permafrost in promoting

surface runoff. Observations of feedback within the slopewash system suggest that these trends may not be universal. In tundra zones, vegetation is thought to be more protective than in the transitional zone of Banks Island. In semidesert and polar desert zones, where vegetation cover in snowbed locations is limited, removal of sediment particles by overland flow may be more significant.

2783 LICHTI-FEDEROVICH, S. - 1983
A Pleistocene diatom assemblage from Ellesmere Island, Northwest Territories; *Geol. Surv. Can.*, Paper 83-9, 59 p.

Diatom analysis of a Pleistocene sediment sample from Cape Storm, Ellesmere Island, dated at 35 000 to 43 000 radiocarbon years, resulted in the identification and ecological characterization of 136 taxa. The diatom thanatocoenosis represents a littoral constituent marked by the preponderance of benthic and epontic species and a neritic component manifested by meroplanktonic forms with cryophilic diatoms and stenothermal taxa. Floristic analysis indicates that deposition occurred in a shallow coastal marine environment having lowered salinities and cold water conditions influenced by ice.

2784 LICHTI-FEDEROVICH, S. - 1984
Investigation of diatoms found in surface snow from the Sydkap Ice Cap, Ellesmere Island, Northwest Territories; *in* Current Research, Part A, Geol. Surv. Can., Paper 84-1A, pp. 287-301.

Qualitative diatom analysis of surficial snow from a polar ice cap resulted in the delineation of two principal floristic components: an allochthonous marine element and an autochthonous freshwater constituent comprising 105 identified taxa. Predominance of aerophilous diatoms affirms positive correlation with other extreme, nonaquatic biotopes.

2785 LORD, C., LAPORTE, P.J., GIBBINS, W.A., SEATON, J.B., GOODWIN, J.A., and PADGHAM, W.A. - 1983
Mineral Industry Report 1978, Northwest Territories; *Ind. Affairs & Northern Develop.*, Yellowknife, N.W.T., 233 p.

2663 MAASS, O. - 1984
Lithostratigraphy and Clay Mineralogy of the CESAR cores, Central Arctic Ocean; unpub. B.Sc. thesis, Queen's Univ., Kingston, 57 p. *CESAR Contr. No. 22.*

2786 MACKAY, J.R. - 1973
Research Proposal - Drained lake experiments for investigation of the growth of permafrost in the western Arctic; *in* Drained lake experiments for investigation of the growth of permafrost in the western Arctic - A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., ed. J.A. Hunter, 1980.

This proposal is for a multi-disciplinary study of the growth of permafrost and its properties, under natural field conditions. The natural field conditions would be created by the drainage of one or more lakes which are on the verge of self-drainage.

2787 MACKAY, J.R. - 1978
Progress report on Illisarvik and Immarnuk - Drainage procedures and initial geological observations; *in* Drained lake experiments for investigation of the growth of permafrost in the western Arctic - A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., Ed. J.A. Hunter, 1980.

The following paper is an excerpt from a Progress Report presented to Illisarvik workers by J. Ross Mackay, October, 1978, in which the drainage procedure is given in detail along with initial geological observations.

2788 MACKAY, J.R. - 1979
Progress report - March 1979; *in* Drained lake experiments for investigation of the growth of permafrost in the western Arctic - A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., Ed. J.A. Hunter, 1980.

2789 MACKAY, J.R. - 1979
Progress report on Illisarvik - Summer 1979; *in* Drained lake experiments for investigation of the growth of permafrost in the western Arctic - A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., Ed. J.A. Hunter, 1980.

2790 MACKAY, J.R. - 1983
Downward water movement into frozen ground, western arctic coast, Canada; *Can. J. Earth Sci.*, vol. 20, no. 1, pp. 120-134.

Field studies carried out mainly since 1975 in permafrost areas of Alaska, Canada, China, and the Soviet Union have been combined with the results of laboratory investigations to show that in summer water can move from the thawing active layer into the subjacent frozen active layer and under certain conditions even into the top of permafrost. Direct field evidence discussed includes: data from drilling and neutron probe logging, which show a summer increase in the ice content of already frozen ground; summer heave of heavemeters, with heave occurring in the frozen active layer; and increase in the ice content of the subjacent frozen ground in both permafrost and non-permafrost areas, caused by snowmelt infiltration. Indirect field and laboratory evidence is also added to support the direct lines of evidence. The conditions that favor the downward migration of water from thawed to frozen ground are examined in terms of thermally induced hydraulic gradients, hydraulic conductivity, content of unfrozen pore water, temperature gradients, ice content, and gravity. Some geocryologic implications of the summer growth of ice in frozen ground, including the effects on water balance calculations and the origin of patterned ground, are briefly mentioned.

2791 MACKAY, J.R. - 1983
Oxygen isotope variations in permafrost, Tuktoyaktuk Peninsula area, Northwest Territores; *in* Current Research, Part B, Geol. Surv. Can., Paper 83-1B, pp. 67-74.

Oxygen isotope variations in permafrost in the Tuktoyaktuk Peninsula area, Northwest Territories, are used in conjunction with other data to provide a range of estimates for the $\delta^{18}O$ values of ice in post-Hypsithermal lake bottom taliks, modern ice-wedge ice, and ground ice of pre-late Wisconsinan age. Some estimates are given for the rate of growth of permafrost in recently drained lakes; the freezing rate at the end of a decade can be less than 0.1 $mm \cdot h^{-1}$. The freezing rates are so slow that the effects of oxygen isotope fractionation should be considered in the interpretation of oxygen isotope variations at sites with both closed and open system freezing.

2792 MACKAY, J.R. - 1983
Pingo growth and subpingo water lenses, western Arctic Coast, Canada; *in* Proc. Fourth Inter. Conf. on Permafrost, Nat. Academy Press, Washington, D.C., pp. 762-766.

Field surveys of hydrostatic (closed) system pingos which are growing in the bottoms of drained lakes have been carried out along the western arctic coast, Canada from 1969-1982. The water pressures beneath a pingo are derived from pore-water expulsion in saturated sandy lake-bottom sediments during permafrost aggradation. A subpingo water lens develops when the pore water pressure uplifts the pingo overburden and intrudes water beneath it. Three growth patterns have been identified for the pingos with subpingo water lenses. (1) Constant year-to-year growth suggesting a balance between water supply and freezing of the water lens; (2) decreasing year-to-year growth suggesting a freeze-through of the sub-pingo water lens; (3) erratic year-to-year growth with periods of increasing height followed by pingo rupture, water loss, and pingo subsidence. The freezing point of the water in a subpingo water lens is depressed slightly below 0°C by a combination of hydrostatic pressure and the concentration of solutes rejected during freezing.

2793 MACKAY, J.R., and MATTHEWS Jr., J.V. - 1983
Pleistocene ice and sand wedges, Hooper Island, Northwest Territories; *Can. J. Earth Sci.*, vol. 20, no. 7, pp. 1087-1097.

Buried ice and sand wedges have been found in glacially deformed sediments that can be no younger than the early Wisconsinan. The environmental conditions at the time of ice-wedge cracking have been inferred from the number of elementary ice veinlets, the vertical extent of the wedges, collapse structures, oxygen isotope ratios, and macrofossils of plants and insects. The winter ground and summer climates were probably as warm or warmer than the present. The preservation of the ice in the ice wedges shows that permafrost has been present at Hooper Island since at least the early Wisconsinan.

2794 MACKAY, J.R. - 1984
The direction of ice-wedge cracking in permafrost: downward or upward?; *Can. J. Earth Sci.*, vol. 21, no. 5, pp. 516-524.

Field studies have been carried out along the western arctic coast of Canada in an attempt to determine whether all ice-wedge cracks originate at the ground surface and therefore propagate downward or whether some cracks originate near the top of permafrost and then propagate both upward and downward. The field studies have been concentrated upon (1) low- and high-centred tundra polygons a few thousand years old; and (2) ice wedges, growing for the first time, on the bottom of a lake experimentally drained in 1978. The field instrumentation has included electronic crack direction indicators, electronic elapsed timers, and continuous temperature measurements. The field studies reveal that many of the ice-wedge cracks originated near the top of permafrost and then propagated upward to the ground surface as well as downward into ice-wedge ice. For the 1974-1982 period, the field observations showed that about 57% of the ice wedges cracked from the ground surface downward and 43% cracked both upward and downward. Furthermore, the vertical direction of ice-wedge cracking was not consistent for any given wedge, presumably because of year-to-year variations in the physical and thermal conditions of the polygons and their troughs.

2795 MACKAY, J.R. - 1984
Lake bottom heave in permafrost; Illisarvik drained lake site, Richards Island, Northwest Territories; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B, pp. 173-177.

In August 1978 a lake (Illisarvik Lake) was artificially drained in a co-operative experiment to study permafrost growth under full-scale natural conditions. Two components of the research are: 1) the measurement of ground temperatures at the northeastern end of the drained lake in order to study the growth of permafrost and 2) the survey of 10 and 20 m-long bench marks installed in the lake bottom to study lake bottom heave arising from permafrost growth. An examination of the first inflexion point in the temperature profile below 0°C shows that the pore water in the lake bottom sands freezes at -0.04°C. Temperature measurements combined with survey data indicate the progressive freezing of unfrozen pore water to at least -0.5°C and some freezing even below -1.0°C. The field evidence from Illisarvik indicates that in closed system freezing, heave may continue for years to decades or even centuries in warm permafrost because of the progressive freezing of unfrozen pore water.

2796 MACKAY, J.R. - 1984
The frost heave of stones in the active layer above permafrost with downward and upward freezing; *Arctic and Alpine Res.*, vol. 16, no. 4, pp. 439-446.

The frost heave of stones in the active layer above permafrost by downward freezing is well known. The phenomenon is usually explained by either the frost-pull or the frost-push theory. However, if the active layer also freezes upward from the late summer frost table, neither the frost-pull nor the frost-push theory can be applied by reversing all of the directions associated

with downward freezing, because the direction of thaw and of gravity cannot be reversed. Laboratory experiments have been carried out to study frost heave with both downward and upward freezing. The laboratory evidence demonstrates that ice lenses can grow on the cold (freezing) side of many stones provided water can migrate from the warm (unfrozen) side of the stones, irrespective of whether the freezing direction is downward or upward. The experiments show that some stones, like some soils, are frost-susceptible. Therefore, the frost-susceptibility of a stone is a factor that must be considered in the study of frost heave irrespective of the direction of freezing.

2797 MacLEAN, B., WOODSIDE, J.M., and GIROUARD, P. - 1984
Geological and geophysical investigations in Jones Sound, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 84-1A, pp. 359-365.

Studies in Jones Sound from CSS Baffin in conjunction with Canadian Hydrographic Service in 1983 included profiling with geophysical and echosounding systems, collection of surficial sediment samples in deep water areas and a few nearshore ice-front localities, as well as local aerial and onshore investigation of coast and beach.

Much of the immediate seafloor in deeper parts of the Sound is composed of fine sediments that appear to be predominantly clay. Glacial till and other acoustically hard and texturally coarser materials, up to gravel size, also are represented.

Bedrock units of possible Precambrian to Paleozoic or younger age tentatively are inferred on the basis of adjacent onshore geology and analogies of seismic and magnetic data with those from other east coast offshore areas.

Preliminary gravity data indicate free-air anomaly values of -100 to -120 mgal in the eastern part of the Sound and less negative values in the west.

2798 MATHEWSON, C.C., and MAYER-COLE, T.A. - 1984
Development and Runout of a Detachment Slide, Bracebridge Inlet, Bathurst Island, Northwest Territories, Canada; *Bull. Assoc. Engineering Geologists*, vol. XXI, no. 4, pp. 407-424.

A detachment slide on Bathurst Island, Northwest Territories, Canada, occurred on an extensively vegetated, south-facing slope of approximately 5°. The slide is 260 m long, 20-30 m wide, generally less than 1 m thick, involves 4,800 m of material, and exhibits four distinct geomorphic zones. These zones are: (1) the source area, characterized by barren ground and depressed topography; (2) the extension zone, characterized by upwelled mud deposits and extension fractures, containing the upslope portion of the slide mass; (3) the compression zone which shows evidence of folding and thrusting of the tundra mat and occurs in the downslope portion of the slide mass; and (4) the disturbed zone, located to the sides and in front of the slide toe, exhibiting simple folding and tension gashes of the tundra mat. It is suggested that the detachment slide developed through a unique set of conditions which are: (1) wind-driven snow is trapped along the lee of the valley ridge, (2) summer melting of the snow provides a supply of water to the head of the slope, and (3) melt water accelerates melting of the permafrost and develops excess pore water pressures. The detachment slide then progresses as follows: (1) downhill creep (solifluction) at the head of the slope increases the tensile stress acting in the vegetative mat until the tundra mat fails, (2) the resulting slide overloads the slope below, leading to a series of progressive detachments, and (3) as the slide progresses downslope, the shear strength of the slope materials increases due to a decreasing water content leading to cessation of movement.

2799 MÄUSBACHER, R. - 1981
Geomorphological mapping in the Oobloyah Valley, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 413-440.

The geomorphological map 1 :25 000 (GMK 25) Oobloyah Bay was dressed in summer 1978 in the frame of the Heidelberg Ellesmere Island Expedition. The aim of the geomorphological mapping program was to test in other climatic zones the suitability of the legend developed in a priority program sponsored by the Deutsche Forschungsgemeinschaft called "Detailed geomorphological mapping in the Federal Republic of Germany". The field work was based on a orthophoto-map 1 : 25 000. The Oobloyah Valley shows the course of a syncline which is bordered by two anticlines, the Krieger Mountains in the N and Neil Peninsula in the S. These three tectonic units are part of the Sverdrup basin, folded during the Eureka orogeny. The syncline was turned into a synclinal valley by glacial processes as, shown by erratic blocks found near the ice cap of Neil Peninsula, during one or several extensive glaciations. To show the climatic parameters of the expedition area the values of the closest weather station (Eureka) had to be used.

Corresponding to the present and paleoclimatic conditions, the greatest part of the mapped area is formed by glacial, fluvioglacial and periglacial processes. The areas influenced by marine processes (isostatic and eustatic variation of sea level) and the geological structure are rare. The additional differentiations in the map - printed in different densities of colour - are related to the age of forms and the influence of secondary geomorphological processes. The present day processes are shown by symbols. They are more frequent in the periglacial and structural units.

The geomorphological processes mapped in the expedition area are typical for this region, but the extension of these areas is depending on the local relief parameters.

2800 MÄUSBACHER, R. - 1981
Near surface soil temperature measurements at Oobloyah Bay, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 487-505.

Soil temperatures have been measured in the field area (Oobloyah Bay, N Ellesmere Island, N.W.T., Canada) at 8

measuring sites with 24 thermocouples (platinum and germanium/arsenic). In order to obtain representative values, thermocouples were inserted at typical locations with different ecological parameters. The maximum temperature of the warmest measuring point was 16, 5°C (69°F), (in 15 cm depth), whereas the coldest amounts to 1, 5°C (35,5°F) only. These differences are caused by the influence of various ecological parameters, such as substratum, water balance and vegetation. The relations between the soil temperatures and the geomorphological processes are briefly discussed.

2801 MAY, R.W., and JONES, B. - 1982
Stochastic Analysis of Complex Lithological Successions; *Mathematical Geology*, vol. 14, no. 5, pp. 405-417.

It is difficult to develop stochastic models for complex lithological sequences that are typically associated with intertidal-supratidal depositional environments. A sequence from the Upper Silurian Leopold Formation on eastern Somerset Island is used to demonstrate that a combination of cluster analysis, Markov Chain analysis, and substitutability analysis can give considerable insight into the nature of such complex successions. The high variability of this sequence was created by a combination of (a) variation in the depositional environment, (b) variation in the degree of dolomitization, (c) variation in the clastic influx, (d) random high-energy (possibly storm associated events) and (e) random breaks in the succession of depositional environments.

2802 MAYR, U., and OKULITCH, A.V. - 1984
Geological maps (1:125 000 scale) of North Kent Island and southern Ellesmere Island, N.W.T.; *Geol. Surv. Can.*, Open File No. 1036, GSC List May 1984.

This unedited Open File consists of three 1:125 000 scale geological maps (Cardigan Strait, 59A, northeast part; Craig Harbour, 49A; Baad Fiord, 49B) and a combined legend. The maps cover the southern flank of the Schei Syncline and are based on fieldwork carried out during the 1981 and 1983 seasons.

2803 McCANN, S.B., and KRAWETZ, M.T. - 1982
Coastal geomorphology and sedimentology in the Arctic Islands; an investigation into the morphology and mobilization of sediments on Arctic Tidal Flats; *Polar Cont. Shelf Proj.*, internal report, 24 p.

Intertidal boulder flats occur in a wide range of tidal and wave energy environments along the coastal expanse of the eastern Canadian seaboard. The morpho-sedimentological development of tidal flats is complicated by the presence of seasonal sea ice which represents the dominant contemporary geologic agent at arctic and subarctic sites. Although sea ice is a singularly important disciplinary study, it becomes a unifying factor within the realm of interdisciplinary coastal research.

The general objective of this study was to investigate the effects of sea ice on the geomorphology and sedimentology in the coastal zone of an arctic setting.

2804 McLAREN, P. - 1982
The coastal geomorphology, sedimentology and processes of eastern Melville and western Byam Martin Islands, Canadian Arctic Archipelago; *Geol. Surv. Can.*, Bull. 333, 39 p.

The coasts of eastern Melville and western Byam Martin Islands have emerged approximately 100 m during the Holocene and are still undergoing isostatic recovery at the rate of approximately 0.35 cm/year. During deglaciation, glacial-marine sediments consisting of 33% sand, 45% silt and 22% clay with variable amounts of gravel and larger sized material reflecting local lithologies were deposited in Byam Channel. SCUBA observations show that there is little present sedimentation on the sand-silt-clay facies but grounding ice blocks result in considerable sediment reworking. Ice keels impinging on the substrate leave long linear scour tracks approximately 2 m deep which are flanked on either side by embankments 1 m high. The ice scour tracks are terminated by a crater which is surrounded by an embankment composed of excavated substrate. On rocky bottoms, where the sand-silt-clay facies is absent, ice scour features contain boulders that are freshly torn from the underlying bedrock.

During emergence, three principal coastal types were formed: deltas, sandflats and raised beaches. The deltas are of the "Gilbert" type consisting of steeply dipping (>10°) foreset beds composed predominantly of sand. Nearshore under-ice tidal currents transport this sand to adjacent coastal areas and it accumulates at the sandflat coast. The mobile sand forms a shallow sandy-facies overlying the glacial-marine sand-silt-clay facies and extends from the shoreline to approximately the 7 m isobath.

Where the shallow sandy facies is thin (<3 m), ice scouring can be sufficiently deep to excavate the underlying sand-silt-clay facies and the resultant ice push deposits containing gravel and larger sized clasts can be added to the beach. Subsequent wave action concentrates the gravel by winnowing away fines and a predominantly gravel beach is formed. The addition of gravel by ice to the beach combined with emergence produces a raised beach coastline. Where the shallow sandy facies is thick (>3 m), the sand acts as a buffer against ice scouring and the gravel content of the sand-silt-clay facies cannot be added to the beach. As the shallow sandy facies emerges a sandflat coastline is formed.

2805 MIALL, A.D. - 1982
Tertiary sedimentation and tectonics in the Judge Daly Basin, Northeast Ellesmere Island, Arctic Canada; *Geol. Surv. Can.*, Paper 80-30, 17 p.

Scattered outliers of nonmarine Tertiary deposits are present at Carl Ritter Bay, Daly River and Pavy River on Judge Daly Promontory, and at Watercourse Valley. At Carl Ritter Bay the section comprises four members: 1. Coarse to pebbly sandstone, 650 + m; 2. Fine grained sandstone, siltstone and shale, 630 m; 3. Siltstone, sideritic mudstone, 460 m; 4. Boulder conglomerate, 630+m. Members 1 to 3 are folded into an anticline - syncline pair and separated from member 4 by an angular unconformity. At Daly River and Pavy River sandstones comparable to (and tentatively correlated with) member 1 at Carl Ritter Bay are exposed, and at Watercourse

Valley a basal breccia is followed by a succession of fine sandstone and siltstone with coal. An outlier previously mapped as Tertiary at Lincoln Bay probably consists of Pleistocene glacial deposits.

Paleocurrent and petrographic evidence suggests that these outliers were originally part of a single depositional entity, herein named Judge Daly Basin. Limited biostratigraphic data indicate that all the strata are Paleocene in age. Most of the sediment was deposited by a fluvial system flowing northeastward, down the axis of the basin, with some input by transverse drainage entering from the margins. Sandstones of member 1 at Carl Ritter Bay are rich in volcanic fragments, particularly feldspar-phyric basalt, possibly derived from an offshore volcanic centre. This detrital component decreases in abundance northeastward, probably due to rapid weathering during transportation.

Member 4 at Carl Ritter Bay is a syntectonic conglomerate, formed during Paleocene fault movements. This tectonic episode is a hitherto unrecognized phase of the Eurekan Orogeny.

2806 MIALL, A.D. - 1984
Sedimentation and tectonics of a diffuse plate boundary: the Canadian Arctic Islands from 80 Ma B.P. to the Present; *Tectonophysics*, vol. 107, pp. 261-277.

Use of a revised magnetic anomaly time scale provides a more accurate chronology of sea-floor spreading events in Labrador Sea-Baffin Bay. New stratigraphic data from Meighen and Remus Basins in the eastern Arctic Islands shows that sedimentary and tectonic events there can be correlated with relative movements of Greenland between 80 and 36 Ma B.P. caused by Labrador Sea-Baffin Bay spreading. Within the eastern Arctic Islands these movements generated the Eurekan Orogeny across the diffuse Greenland-Canada plate boundary. Subsequently the Arctic Islands were affected by uplift and erosion, and then by extensional faulting and renewed clastic sedimentation between 15 Ma B.P. and the present.

2807 MICHEL, F. - 1979
Progress report - May 1979; *in* Drained lake experiments for investigation of the growth of permafrost in the western Arctic - A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., Ed. J.A. Hunter.

2808 MICHEL, F., and FRITZ, P. - 1982
Laboratory and field studies to investigate isotope effects occurring during the formation of permafrost - Part IV; *Earth Phys. Br.*, Open File No. 82-5, 83 p.

Observations on the distribution of oxygen and hydrogen isotopes in permafrost waters have been completed at a drained lake site in the Mackenzie Delta, along the Dempster Highway. Additional laboratory observations of isotope fractionation in phase change were completed. The analyses are used in conjunction with C^{14} dates to delineate the history of the drained lake basin over the past 9000 yrs. and to examine permafrost history and the origin of the waters in the northeastern Yukon.

2809 MICHEL, F.A. - 1982
Isotope investigations of permafrost waters in northern Canada; unpub. Ph.D. thesis, Univ. Waterloo, 441 p.

About 50% of Canada is underlain by permafrost, which often contains large quantities of ice. Since water is composed of hydrogen and oxygen atoms, isotopic studies of these elements were considered to be a potentially useful tool for tracing the history of individual water molecules. Preliminary field data indicated that large isotope variations of approximately 11 $^{o}/_{oo}$ in oxygen-18 contents, as well as smaller fluctuations, are preserved in the permafrost. Therefore, a combined approach of laboratory and field studies was undertaken to investigate the isotope contents of permafrost waters.

A series of sixteen experiments was undertaken in the laboratory, to examine the formation of isotope variations as a result of fractionation during freezing. Variations generated as a result of freezing (phase change) formed primarily in fine grained soils as positive and negative peak couplets or single-sample positive peaks within a 5 cm interval. The magnitude of these fluctuations was never found to exceed the 3 $^{o}/_{oo}$ (for ^{18}O) equilibrium fractionation factor of the pure ice-water system, regardless of soil type. The oxygen and hydrogen isotopes displayed similar trends, in which ^{18}O and ^{2}H were preferentially incorporated in the ice phase while the residual water became depleted. Large isotope variations which could be described by the Rayleigh distillation model were developed in confined water columns. None of the variations developed in the laboratory could be sustained with depth.

Isotope investigations of permafrost waters collected in the field from two proposed pipeline routes and a detailed study site (named Illisarvik) in the Mackenzie Delta; displayed single-sample variations, similar to the laboratory experiments, in addition to much larger isotope shifts. The full complexity of the isotope record preserved in the permafrost waters was only revealed when the sampling interval was reduced to less than 5 cm. Accumulation of the heavy isotope due to fractionation during freezing permitted the determination of the active layer thickness, the delineation of paleo-permafrost surfaces, and the detection of the position (s) where the freezing front had been stabilized for a prolonged period of time.

The large shifts in the isotope contents have been found to be as large as 11 $^{o}/_{oo}$ for ^{18}O and are considered to be the result of changes in climate. These shifts can be either positive or negative, but generally are continuous over some interval of depth. Under ideal conditions where permafrost of various ages has formed, a record of ground water movement and climatic change can be preserved. If temperature is considered to be the major factor influencing the alteration of isotope contents in precipitation during the period of climatic change, then an estimate of the temperature change can be obtained.

2810 MICHEL, F.A., and FRITZ, P. - 1982
Significance of isotope variations in permafrost waters at Illisarvik, N.W.T.; *in* Proc. 4th Can. Permafrost Conf., March 2-6, 1981, Calgary, Alta., Nat. Res. Council, The Roger J.E. Brown Memorial Volume, pp. 173-181.

Analyses for ^{18}O and ^{2}H contents in permafrost cores from the Mackenzie River basin revealed very large depletions in the heavy isotope contents with depth. These shifts could be a reflection of decaying climatic conditions resulting in lower ^{18}O and ^{2}H contents in older ice or, under special circumstances, might be due to isotope fractionation processes occurring during freezing. Thus, as part of a detailed study of permafrost growth at the drained lake site known as Illisarvik on Richards Island in the Mackenzie Delta, a number of continuous cores were collected from within, and adjacent to, the lake bed. Water extracted from the samples by squeezing was analyzed for ^{18}O, ^{2}H, and ^{3}H isotopic contents in addition to conductivity. The soils were examined for grain size and moisture content, while organic-rich horizons were dated using the radiocarbon method. Radiocarbon dating of the lake-bed sediments indicate that the lake initially formed some 6700 to 8700 years ago. The ^{18}O contents from the Illisarvik lake bed are in the range of -15 to -16 per mille near the surface, which are similar to the average lake water prior to drainage. Outside of the lake, ^{18}O contents vary from -14 to -31 per mille. Tritium is confined to the active layer outside of the lake, while within the lake bed tritium occurs to a depth of 2 m. The results of this and other ongoing studies into the distribution of stable and radioactive isotopes occurring naturally in waters related to permafrost indicate that such investigations provide valuable insight into the history and origin of these waters.

2811 MICHEL, F.A., and FRITZ, P. - 1983
Isotope investigations in permafrost regions; *Earth Phys. Br.*, Final Report, Open File No. 83-3, 63 p.

The results are reported of oxygen isotope measurements on core and massive ice samples collected along the Alaska and Dempster Highways in the Yukon and at Illisarvik Lake in the Mackenzie Delta. Analysis of the results reveals some interesting implications for past climate in the Yukon and the relationship to groundwater movement and the age and history of permafrost growth.

2812 MITCHELL, R.H., and PLATT, R.G. - 1984
The Freemans Cove volcanic site: field relations, petrochemistry, and tectonic setting of nephelinite - basanite volcanism associated with rifting in the Canadian Arctic Archipelago; *Can. J. Earth Sci.*, vol. 21, no. 4, pp. 428-436.

The Eocene volcanic suite of the Freemans Cove area of Bathurst Island, Canadian Arctic Archipelago, consists of dikes, sills, small plugs, and agglomeratic vents. Lavas are preserved only as clasts in the vents. The bulk of the magmatism consists of nephelinite or larnite-normative nephelinites and basanites. Subordinate members of the suite include olivine melilite nephelinites, phonolites, and tholeiitic and alkali basalts. The magmatism is bimodal and intermediate rocks are absent. Many of the nephelinites and basanites have the geochemical characteristics of primary magmas, and it is proposed that these members of the suite represent an integrated series of primary melts erupted in an essentially unmodified state from the upper mantle. Other members of the suite are generated by the combined efforts of high- and low-pressure differentiation of the primary melts. The igneous rocks are confined to the grabenlike Southeast Bathurst Fault Zone and were emplaced during uplift and compression of the region by the Eurekan rifting episode. The magmatism has the petrological characteristics of intraplate continental magmatism of the type commonly associated with rifting and doming.

2664 MUDIE, P.J., and AKSU, A.E. - 1984
CESAR cores: Lithostratigraphic correlation and paleoenvironmental interpretation of Alpha Ridge Cretaceous and Late Cenozoic sediments; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 84.

2666 MUDIE, P.J., and BLASCO, S.M. - 1985
Lithostratigraphy of the CESAR cores; *Geol. Surv. Can.*, Paper 84-22, pp. 59-99. *CESAR Contr. No. 13.*

2667 MUDIE, P.J. - 1985
Palynology of the CESAR cores, Alpha Ridge; *Geol. Surv. Can.*, Paper 84-22, pp. 149-174. *CESAR Contr. No. 18.*

2813 MUIR, I.D., and RUST, B.R. - 1982
Sedimentology of a lower Devonian coastal alluvial fan complex: the Snowblind Bay Formation of Cornwallis Island, Northwest Territories, Canada; *Bull. Canadian Petroleum Geology*, vol. 30, no. 4, pp. 245-263.

Vertical movement of the north-south Boothia Uplift affected regional sedimentation in the central Arctic Islands during Early Devonian time. Synorogenic and postorogenic clastic wedges derived from the uplift and deposited in flanking basins include the Snowblind Bay Formation of Cornwallis Island.

The Snowblind Bay Formation, 578 m thick, has been divided into three facies associations based on constituent lithologies, sedimentary structures and biota. The fine-grained facies association (70-220 m thick) contains less than 10% conglomerate and occurs at the base of the formation. The sequence is noncyclic and shows evidence for an intertidal depositional environment, including a probable *Skolithos* ichnofauna, ostracoderm fragments, abundant soft-sediment deformation structures, pinstripe bedding and rare resedimented conglomerate units. A nearshore mud-flat facies assemblage can be broadly distinguished from a more offshore sand flat - tidal flat facies assemblage by the presence of terrestrial conglomerate units, scarcity of faunal elements, higher mud content, and a relatively higher abundance of low-energy bedforms and stratification.

The overlying conglomerate-sandstone facies association (120-300 m thick) contains 10-90% conglomerate. Lithofacies display sheet-form geometry and are arranged into two distinct types of fluvial cycle, one sand-dominated, the other gravel-dominated. The gravel-dominated sheet-flood cycle (average 3.7 m thick) formed from higher-discharge events.

The capping conglomerate facies association (210-240 m thick) contains more than 90% horizontally bedded conglomerate. The succession is dominated by conglomerate-sandstone flood cycles (1-6 m thick) arranged in coarsening-upward and coarsenings, then fining-upward sequences (7-30 m thick). The depositional environment is inter-

preted as the midreaches of an alluvial-fan complex. The sheet-braided and sheet-flood cycles in the conglomerate-sandstone facies association represent the distal-fan equivalent of the mid-fan flood cycles.

The Snowblind Bay Formation is interpreted as a coastal-fan complex that was derived from a north-northwest source, possibly from reactivated fault scarps that also may have controlled the Ordovician - Upper Silurian basin (Cape Phillips Formation) to shelf (Allen Bay Formation, Read Bay Group) facies change in the Laura Lakes district.

2814 MUIR, I.D., and RUST, B.R. - 1983
Sedimentology of the Snowblind Bay Formation, Cornwallis Island, N.W.T.; *in* Mineral Industry Report 1978, Northwest Territories, Ind. Affairs & Northern Develop., Yellowknife, N.W.T., Chapt. IX, pp. 161-171.

The Lower Devonian Snowblind Bay Formation is a 577-m thick, coarsening-upward sequence of terrigenous clastic sediments. Current research includes the systematic study of 1) sedimentology; 2) process-response relationships to source areas during tectonic uplift; 3) paleogeographic reconstructions and 4) comparison to other regressive clastic wedges along the Boothia Uplift during Upper Silurian and Lower Devonian time.

This report considers the sedimentology of the Snowblind Bay Fm as a regressive coastal fan complex.

The north-trending Boothia Uplift rose and, during Upper Silurian - Lower Devonian time, synorogenic and postorogenic mo l asse wedges were shed from it. These include rocks forming the Peel Sound Formation, Snowblind Bay Formation, and Prince Alfred Formation.

The Snowblind Bay Formation is preserved in a broad, open, northeast plunging syncline. Its l[illegible]er contact is arbitrarily defined as the base of the stratigraphically lowest conglomerate bed. The underlying Sophia Lake Formation represents a package of sediments that was deposited in an essentially shallow, subtidal to intertidal environment.

The remainder of this report will deal with the sedimentology of a progradational coastal fan complex consisting of the lowermost fine-grained facies association or tidalite sequence; sandstone-conglomerate facies association or distal alluvial fan complex; and the uppermost conglomerate facies association or mid-proximal alluvial fan sequence.

2815 NAGEL, G. - 1979
Untersuchungen zum wasserkreislauf in periglazialgebieten; *in* Kanada und das Nordpolargebiet, Trierer Sym. vom 30. Oktober bis 1. November 1976 aus Anlaß der Eröffnung der Ausstellung,, Das Nordpolargebiet und seine Menschen''; Veranstalter: Universität Trier, Deutsche Gesellschaft für Polarforschung, Botschaft von Kanada Bonn, pp. 157-178.

2816 NARBONNE, G.M., and PACKARD, J.J. - 1982
Trace fossils in Siluro-Devonian carbonates on Somerset, Griffith, Cornwallis and Devon Islands, Arctic Canada; Third North American Paleontological Convention, Montreal, Quebec, Canada, August 5-7, 1982, *Abstract in* J. Paleontology, vol. 56, Suppl. no. 2, p. 20.

The Upper Silurian to Lowest Devonian Somerset Island Formation, Barlow Inlet Formation, and member C of the Cape Phillips Formation were deposited under conditions which ranged from tidal flat in the south to basin slope in the north. Trace fossils can be identified in approximately 20% of field units in this predominantly carbonate succession. *Planolites, Palaeophycus, Chondrites* and *Skolithos* are common in all the environmental zones recognized. Six commonly occurring ichnogenera exhibit restricted environmental distributions: *Polarichnus* is confined to tidal flat deposits: *Zoophycos* and *Pilichnia* are most common in deep subtidal shelf and upper basin slope deposits; and *Phycodes, Pelecypodichnus* and *Taenidium* occur predominantly in basin slope deposits. Nine other ichnogenera, *Arenicolites, Arthraria, Cochlichnus, Cruziana, Diplocraterion,* cf, *Furculosus, Helicodromites, Teichichnus* and cf. *Thalassinoides,* occur only very rarely.

Trace fossil assemblages of the tidal flat and subtidal shelf carbonates are broadly similar to the *Skolithos* and *Cruziana* Ichnofacies reported from environmentally equivalent siliciclastic deposits. Similarly, the assemblage of the deep subtidal-upper basin slope carbonates is similar to the environmentally equivalent *Zoophycos* Ichnofacies. In contrast, the assemblage of the basin slope carbonates comprises abundant resting and feeding traces (*Cruziana* Ichnofacies) whereas assemblages of siliciclastic slope deposits are dominated by complex grazing traces and graphoglyptids (*Nereites* Ichnofacies).

2817 NARBONNE, G.M., and DIXON, O.A. - 1982
Physical correlation and depositional environments of Upper Silurian rubbly limestone facies in the Canadian Arctic Islands; *in* Arctic Geology and Geophysics, eds. A.F. Embry and H.R. Balkwill, Can. Soc. Pet. Geologists Memoir 8, pp. 135-146.

The Douro Formation, one of the most widely recognised units in the Canadian Arctic Islands, consists predominantly of rubbly-weathering grey limestone with abundant smooth-shelled brachiopods. The relatively monotonous lithologic and paleontologic character of the formation hinders internal stratigraphy, and makes it difficult to trace individual beds for more than a few hundred metres. Nevertheless, consideration of the overall character of the Douro Formation over several tens of metres thickness permits recognition of more widely traceable units. Presence of argillaceous divisions and coral-rich zones provides two independent, supplementary criteria which can be used to correlate sections on southeastern Somerset Island. Coral-rich zones and associated reefs occur in similar stratigraphic positions on Somerset, Cornwallis and Devon Islands. Variation in total shale content between sections makes interisland recognition of the argillaceous divisions more difficult, but on all three islands the lower part of the formation tends to be more argillaceous than the upper.

The Douro Formation was deposited on a subtidal shelf, probably in warm, turbid, predominantly tranquil waters. On southeastern Somerset Island, the subtidal Douro Formation lies conformably between two predominantly inter-

tidal formations, and was deposited in two successive transgressive-regressive cycles. Sponge reefs characterised the two deepest parts of cycles, whereas oolites and oncolites formed rarely in the shallower parts of the cycles. The amount of argillaceous detritus in the rubbly limestones was largely independent of bathymetry, and was probably controlled by changes in the source area and in distribution patterns. The terrigenous content of the rubbly limestones increases regularly in a northeasterly direction.

2818 NARBONNE, G.M. - 1984
Trace fossils in Upper Silurian tidal flat to basin slope carbonates of Arctic Canada; *J. Paleontology*, vol. 58, no. 2, pp. 398-415, 10 Figs.

Upper Silurian carbonates on Somerset, Cornwallis and Devon islands contain numerous trace fossils. A *Polarichnus-Bergaueria* ichnoassociation characterizes limestones and dolostones deposited in the intertidal zone (Cape Storm and Leopold formations), a *Fuersichnus-Uchirites* ichnoassociation characterizes limestones deposited under shallow subtidal conditions (Douro Formation), and a *Neonereites* ichnoassociation characterizes basin-slope limestones (tongue of ?Cape Phillips Formation).

Trace fossils in planar-bedded calcisiltite and dolosiltite were preserved through toponomic processes, which resulted in diverse ichnoassemblages similar to those reported from contemporaneous shallow marine siliciclastic rocks. In contrast, trace fossils in bathymetrically equivalent rubbly (nodular) calcilutite were preserved through diagenetic processes, which resulted in ichnoassemblages largely restricted to infaunal feeding and dwelling traces. Although the mineralogic composition of the substrate is probably relatively unimportant in controlling the distribution of trace-making organisms, the greater susceptibility of carbonates to early and late diagenetic processes can significantly affect the nature of the ichnocoenose.

Characters resulting from formational and preservational processes of trace fossils suggest that the calcilutite substrates were generally firm, whereas calcisiltite substrates ranged from firm to thixotropic. Simple, "non-diagnostic" burrows such as *Palaeophycus* can contribute a wealth of information on substrate consistency much of it not readily available from more traditional environmental indicators.

2819 NARBONNE, G.M., and DIXON, O.A. - 1984
Upper Silurian lithistid sponge reefs on Somerset Island, Arctic Canada; *Sedimentology*, vol. 31, pp. 25-50.

The Upper Ludlow Douro Formation contains the first reported Silurian sponge reefs. These relatively small (5-35 m diameter), mound-shaped structures contain, on average, 35% lithistid demosponges. Reefs are surrounded by irregular haloes of crinoid debris; abundance and diversity of all fossil groups decreases away from the reefs. Each reef is underlain by a lens of crinoid wackestone to grainstone rich in crinoid holdfasts; trepostomate bryozoans, solenoporacean algae and rhynchonellid brachiopods are locally common. The bulk of each reef consists of lime mudstone with abundant lithistid sponges. This is capped by a thin layer of wackestone with abundant tabulate and rugose corals and fewer lithistid sponges, calcareous algae, trepostomate bryozoans and stromatoporoids. This zonation, in which a sponge colonization community was replaced by a coral diversification community, is similar to that reported from some Middle Ordovician, Upper Jurassic and Holocene sponge reefs.

The Douro sponge reefs were relatively low structures, with about 3 m maximum topographic relief. They grew on a broad carbonate platform, probably in warm, tranquil, turbid waters of normal or near-normal marine salinity. Periodic influxes of terrigenous mud adversely affected reef size, and caused biotic changes. Some of the reef lime mud was derived from non-reef sources, but significant quantities were also produced on the reefs. Reefs underwent synsedimentary lithification, bioerosion and minor storm erosion. Fabrics and compositions of sparry calcite in cavities record three generations of meteoric cementation. Originally siliceous spicules of the lithistid sponges were dissolved and the moulds later filled with sparry calcite. Early dissolution of siliceous spicules is common in reef environments, and may have caused fossil sponges to be under-represented in ancient reefs.

2820 O'CONNOR, M.J. & ASSOCIATES LTD. - 1982
An evaluation of the regional surficial geology of the southern Beaufort Sea; A Report for the Geol. Surv. Can., 188 p.

The geologic model of the Canadian Beaufort Sea continental shelf first proposed by the Geological Survey of Canada has been laterally developed by dividing the shelf into nine physiographic regions, based on a combination of seafloor bathymetry, sediment types and the paleotopography of the most recent unconformity surface.

Good correlation is apparent between the physiographic regions and the occurrence of specific acoustic permafrost types noted in previous studies. In addition, each physiographic region appears to be associated with a set of uniquely characteristic geological and geotechnical properties, and hence the divisions form an important basis for evaluating and predicting the engineering properties of the surficial sediments on the shelf. In particular, these divisions can be used to appraise the potential for the development of granular resources in each area, provide a preliminary assessment of foundation conditions at well-sites where no geotechnical or geological information is yet available, and identify suitable criteria for establishing pipeline burial depths to reduce the opportunity for damage due to ice scour.

The report concludes that each physiographic region represents an area of the shelf which has been subjected to a unique set of geological and geothermal processes, and recommends that additional detailed studies of each region be undertaken to provide an enhanced understanding of the surficial geological conditions on the continental shelf.

2821 PACKARD, J., and DIXON, O.A. - 1983
Stratigraphy of an Upper Silurian carbonate shelf sequence on Cornwallis and nearby islands; *in* Mineral Industry Report 1978, Northwest Territories, Ind. Affairs & Northern Develop., Yellowknife, N.W.T., Chapt. X, pp. 173-188.

2822 PACKARD, J.J., and DIXON, O.A. - 1982
Carbonate buildups associated with a progradational basin-slope succession from the Upper Silurian of Arctic Canada; *Abstract in* Proc. Eleventh Inter. Congress on Sedimentology, McMaster Univ., Hamilton, Ontario, Canada, August 22-27, p. 117.

Epeirogenic uplift of the Boothia Horst in late Ludlow-early Pridoli time resulted in episodic northward progradation of shelf-margin facies (Barlow Inlet Fm) in the Cape Rescue area, Cornwallis Island. The resulting succession of shallowing-upward carbonate cycles contains numerous and diverse organic buildups. The apparent lateral extent, overall faunal abundance and diversity, framework complexity and matrix grain size of the buildups all increase upslope. The stratigraphic heights of proximal slope buildups (4-12m), are generally smaller than the deeper-water reefs (14-18m).

The basin-slope succession includes: a) distal facies with unfossiliferous hemipelagic (ribbon) lime mudstones, a *Skolithos-Phycodes* ichnofossil assemblage, and rare but conspicuous hardgrounds, nodular limestones and rotational slide structures; b) *proximal facies* with authochthonous, planar to wavy-bedded crinoidal wackestones and poorly fossiliferous lime mudstones with crinoid holdfast networks, a *Zoophycus* ichnofossil assemblage, translational slides and related debris flows, and local lithistid sponge-rhizoid holdfast-mucophyllid mud mounds; and c) *framework reef and debris apron facies* with lamellar to hemispherical stromatoperoids, favositida, cerioid rugosans, dasyclad algae and rhizoid holdfasts in a crinoidal wackestone matrix, resting on thick, extensive blankets of rudaceous crinoidal packstone. The location of the main buildups was possibly related to submarine expression of the principal N-S growth-faults of the Boothia Horst.

2823 PACKARD, J.J. - 1984
The Upper Silurian Barlow Inlet Formation, Cornwallis Island, Arctic Canada; unpub. Ph.D. thesis, Univ. Ottawa 791 p.

Outcropping on Cornwallis and Griffith Islands of the central Canadian Arctic, the lower member of the Upper Silurian Barlow Inlet Formation is a thin (50 m), siliciclastic sequence, stratigraphically entombed in a 2700 m thick succession of relatively pure carbonates. The lower member overlies the Douro Formation conformably, but very abruptly; this contact represents an event horizon signalling a major late Ludlovian pulse of the Cornwallis Disturbance. The lower member itself is composed predominantly of dark mudrocks of 'black shale' aspect, and these mudrocks are interpreted as prodelta sediments deposited in an intermittently anoxic basin. A sandy facies consists of fine-grained, in part bimodally-sorted, subarkose characterized by low-inclined parallel lamination, Runzelmarken, desiccation polygons, asymmetric ripples, primary current lineation, and a *Cruziana* trace fossil assemblage. The subarkose facies is interpreted as beach shoreface facies.

The lower member resulted from continental mass-wasting of nearby epeirogenic uplands. The detrital source cannot be determined with certainty, but a source area to the south and east of Cornwallis Island is suggested by the thickness distribution of the lower member. The deltaic sediments that constitute the lower member represent a part of the marine record of Caledonian diastrophism that affected the Boothia Uplift region as well as other parts of the arctic archipelago. The tectono-sedimentary record of Cornwallis Island during this time can be satisfactorily interpreted in terms of pre-epeirogenic, initial epeirogenic, epeirogenic, and immediately post-epeirogenic phases.

The upper member of the Barlow Inlet Formation contains a significant proportion of peritidal lithofacies arranged in hemicyclic series. Two shallowing-upward sequences are recognized: a Restricted Infratidal (RI) Hemicycle and a Tidal Flat (TF) Hemicycle. Each complete cycle contains four members, representing higher energy subtidal lagoon or proximal back-barrier facies through to tidal flat facies.

The RI hemicycles consist of 1) a basal biostromal member, 2) a sparsely fossiliferous mottled dolomitic carbonate member, 3) a massive carbonate mudstone member, and 4) a laminated member. The TF hemicycles consist of 1) a basal oncoidal carbonate member, 2) a mottled carbonate member, 3) a massive carbonate member, and 4) a laminated member. The hemicyclic sediments were deposited in an arid climate on a carbonate platform rimmed by crinoid sand shoals and/or stromatoporoid-dominated biostromes and buildups, subject to ?minimal wave stress.

The muddy lithofacies and overall setting of the platform compares favourably with present day Florida Bay, as well as ancient back-reef sequences described in the Devonian and Triassic systems.

The TF and RI hemicycles represent co-existing and intergradational environmental regimes. Depths likely did not exceed 7m anywhere on the shelf. Hemicyclicity is best explained in terms of an episodic subsidence and tidal flat progradation model; eustatic sea-level rises need not be invoked.

The Barlow Inlet Formation represents a major carbonate platform complex, over 1.2 km thick. Biocumules, herein defined as variably-shaped concentrations of in-situ organisms and contiguous sediment (collectively embracing biostromes and buildups), occur throughout this complex. They are considered to have developed in depositional environments ranging from medial foreslope to restricted lagoon. Ten biocumule facies are recognized and include: lithistid sponge dominated mud mounds, mucophyllid mud mounds, diverse community mud mounds, fasciculate rugose coral biostromes, stromatoporoid - crinoid rubble skeletal buildups, dolomitized massive skeletal (?crinoid) biocumules, lamellar stromatoporoid biostromes, massive stromatoporoid biostromes, dendroid stromatoporoid biostromes, and *Coenites* - capped fenestral mud mounds. In addition several biocumules exhibit internal vertical zonation of biofacies, and are here described under the term 'zoned biocumules'.

Buildups and biostromes of late Silurian-early Devonian age are poorly represented in the literature, and detailed descriptions of complete platform complexes from continental margin settings are unknown. Biocumules of the Platform Margin are most closely comparable to the reef succession of Gotland, Sweden. Platform Interior facies bear close resemblance to Middle and Upper Devonian backreef sequences. Basin Slope biocumules show similarities to late Silurian carbonate ramp buildups

in Arctic Canada and foreslope sponge mud mounds of the European Jurassic.

Eight major facies associations, herein called superfacies, are recognized in the Upper Silurian carbonate member of the Barlow Inlet Formation on Cornwallis Island. These superfacies represent environments ranging from distal foreslope (in contact with anoxic basal water mass of the Cape Phillips Basin), through rimmed shelf edge to tidal flat. The environments were associated with a large attached interior platform straddling a flexure between stable craton and miogeocline. Medial foreslope, proximal foreslope, shelf edge and proximal back-barrier superfacies contain diverse buildups and biostromes, that represent biota that apparently flourished in oxygenated near-surface waters of the basin.

The platform (Barlow Inlet Platform) evolved from a precursor ramp (Douro Ramp) by structural modification commensurate with subjacent block faulting of the Boothia Horst in latest Ludlovian time. Continued spasmodic epeirogeny affecting this basement structure, controlled periodic areal enlargement and drowning of the platform. These principal forestepping and backstepping events were superimposed on longer term accretionary outbuilding and regional subsidence. In early-mid Lochkovian time the platform emerged during a third pulse of the Cornwallis Disturbance.

The distal basin slope and cyclic platform interior facies are largely indistinguishable from the C member of the Cape Phillips Formation of northern Cornwallis Island, and the lower member of the Somerset Island Formation of northern Somerset Island, respectively. However mapping contingencies dictate that formational boundaries remain unchanged.

2824 PALMER, H.C., BARAGAR, W.R.A., FORTIER, M., and FOSTER, J.H. - 1983
Paleomagnetism of Late Proterozoic rocks, Victoria Island, Northwest Territories, Canada; *Can. J. Earth Sci.*, vol. 20, pp. 1456-1469.

Late Proterozoic Natkusiak plateau basalts and associated dolerite dikes and sills of Victoria Island show paleomagnetic polarities that relate them to the Franklin diabases but are complicated by the effects of a downward component that cannot be wholly removed in all sites by AF and thermal demagnetization. In a preserved thickness of about 740 m of Natkusiak flows the polarity changes upward in roughly successive thirds of the section from east and slightly downward (reverse), to west and slightly downward (normal), to east and slightly upward (reverse). Thus there is a double reversal in the section but the lower reverse direction is badly contaminated by a downward directed overprint. At three sites this steep downward component persists after cleaning. Dolerite polarities, except for one that is normal, cluster in the east-down (reverse) direction close to the lower reverse direction of the lavas and steeply downward, similar to the overprint direction in the flows. The downward component can be correlated with evidence of low initial oxidation and more severe alteration in the corresponding samples and may be related to burial metamorphism. The reverse direction of the upper lavas, being from the freshest parts of the section and closest in direction to the exact reversals recorded in Franklin dikes from Baffin Island, is believed to be most reliable. Paleopole positions are: upper reverse lavas, 161°E, 2°N; middle normal lavas, 159°E, 9°N; combined middle-upper lavas, 159°E, 6°N ($\delta p = 4^\circ$, $\delta m = 8^\circ$).

Reynolds Point shales from the Shaler Group underlying Natkusiak basalts and host to the dolerite sills yielded a paleopole position at 147°E, 6°S, significantly removed from the Franklin poles but probably not indicative of an age greater than Hadrynian.

2825 PARKINS, W.G. - 1983
Functional morphology of some Upper Silurian solitary rugosa from the Douro Formation of Somerset and Cornwallis islands, Canadian Arctic Archipelago; *Abstract in* Proc. Can. Paleontology & Biostratigraphy Seminar, Univ. Toronto, Sept. 23-25, 1983, p. 24.

Most solitary rugose corals maintained a stable position above the substrate by using talons or stolons to firmly attach themselves to a hard surface, often the dead skeletal debris of other organisms. However, small, conical solitary rugosans in which the development of talons or stolons are either poorly developed or absent, present problems in reconstructing their paleoecology. A study of three species of this type, *Pycnactis mitratus*, *P.* n.sp. A, and STAUROMATIDIIDAE n.gen. B. n.sp. A, is presented here. All three species have the following characteristics in common: small to medium size; a conical shape with little or no evidence of attachment surfaces; a marked development of thick septal stereozones; and an association with micrite lithologies. They differ from one another in the amount and position of the septal stereozones within the coral.

In the Douro Formation of Somerset and Cornwallis Islands these forms are found in great abundance within beds of micrite deposited under relatively low energy conditions between wave base and storm wave base. A careful study of specimens in apparent life position has led to the conclusion that the thick septal stereozones acted as 'ballast' to maintain the coral in a stable position as a semi-infaunal organism adapted to soft bottom carbonate substrates or carbonate substrates where large fragments of skeletal debris were absent. This ability to secrete a septal stereozone to be used as ballast freed these organisms from the necessity of finding a suitable hard substrate for attachment and stability. It allowed them to invade substrates where other rugosans were excluded and thus avoid direct competition with them.

2826 PEDDER, A.E.H. - 1982
New Zlichovian (Early Devonian) rugose corals from the Blue Fiord Formation of Ellesmere Island; *in* Current Research, Part C, Geol. Surv. Can., Paper 82-1C, pp. 71-82.

The genera *Taimyrophullum*, *Cavanophullum* and *Radiastraea* are reviewed. A lectotype is chosen for *Phillipsastraea scheii* Loewe, 1913, to make it a junior objective synonym of *Iowaphyllum* alpenense. This allows *Taimyrophyllum nolani* Merriam, 1974, which would otherwise be a junior subjective synonym of *Phillipsastrea scheii*, to stand. *T. nolani beaumannense* subsp. n., *Cavanophyllum uyenoi*

sp. n. and *Radiastraea pulchra* sp. n. are described from the early Zlichovian part of the dehiscens Zone, at localities close to the outcrop known as the Sor Fiord section, on southwest Ellesmere Island, arctic Canada. *Cavanophyllum uyenoi* sp. n. also occurs in the slightly younger Zlichovian *Polygnathus aff. perbonus* conodont unit in the Sor Fiord section.

2827 PEDDER, A.E.H. - 1982
Probable Dalejan (Early Devonian) cystiphyllid corals from Bird Fiord Formation of Ellesmere Island; *in* Current Research, Part C, Geol. Surv. Can., Paper 82-1C, pp. 83-90.

Two new species, *Lekanophyllum retiforme* and *L. rugulosum*, are described from Blubber Point, southwest Ellesmere Island. *L. retiforme* is the commonest coral in the Bird Fiord Formation of this area, but, because of its unusual morphology, invariably has been misidentified in previous literature.

2607 PEDDER, A.E.H. - 1985
Lochkovian (Early Devonian) rugose corals from Prince of Wales and Baillie Hamilton islands, Canadian Arctic Archipelago; *in* Current Research, Part B, Geol. Surv. Can., Paper 85-1B, pp. 285-301.

2828 POEY, J-L. - 1982
Preliminary report on Upper Ordovician to Upper Silurian carbonates, Baumann Fiord area, southwestern Ellesmere Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 82-1A, pp. 75-77.

The Upper Ordovician - Lower Devonian Allen Bay Formation and Read Bay Group are a sequence of partially dolomitized, shallow shelf carbonates, throughout the Arctic Islands. Towards the northwest, however, this sequence undergoes a major facies change to basinal shales. This facies boundary tends generally northeast bisecting the area studied at Baumann Fiord, on Ellesmere Island. Two trends can clearly be observed in rocks representing the transitional slope environment. First, slope and shelf margin debris flows become predominantly basinal carbonate mudstone, and eventually calcareous shale northwestward. Second, there is a general upsection trend from shelf and slope facies to basinal carbonates and calcareous shale. A major break occurs at a cherty, fine dolomitic interval, with shelf limestones and dolostones beneath and slope and basinal carbonates above ranging from debris flow breccias to laminated carbonates and calcareous shales. The intervening cherty unit provides a widespread, distinctive lithological marker.

2829 POLAN, K.P., and STEARN, C.W. - 1984
The allochthonous origin of the reefal facies of the Stuart Bay Formation (Early Devonian), Bathurst Island, arctic Canada; *Can. J. Earth Sci.*, vol. 21, no. 6, pp. 657-668.

Blocks of limestone and dolomite up to tens of metres across occur near the base of the Lower Devonian (Siegenian-Emsian) Stuart Bay Formation at six sites on eastern Bathurst Island. These blocks occur in groups of up to 30. At the two localities with the greatest number of blocks they are disposed in two or three roughly linear groups reflecting their occurrence on bedding planes. The blocks are mostly wackestones and floatstones and they contain abundant fossils of the reefal biofacies of which stromatoporoids and corals are most prominent.

The blocks have weathered from a matrix of finely laminated deep-water siltstone. Most of the blocks are unbedded but where bedding attitudes can be measured they are discordant with that of the siltstone and those of neighbouring blocks. Although they have been described as bioherms that grew in place, the evidence indicates that they are allochthonous blocks derived when several catastrophic events such as earthquakes disturbed a Devonian reef tract developed on the western flank of the Cornwallis Fold Belt.

2830 POLLARD, W.H., and FRENCH, H.M. - 1983
Seasonal frost mound occurrence, North Fork Pass, Ogilvie Mountains, northern Yukon, Canada; *in* Proc. Fourth Inter. Conf. on Permafrost, Nat. Academy Press, Washington, D.C., pp. 1000-1004.

Between 1980 and 1982 a total of 65 seasonal frost mounds were observed at several localities in the North Fork Pass, interior northern Yukon. The majority were of the frost blister variety, although icing blisters and icing mounds also occurred. The largest was 3.5 m high. Several persisted for more than 1 year and a few experienced reactivation and further growth in a second winter. Stratigraphic investigations, together with ice fabric analyses, suggest the mounds result from the freezing of suprapermafrost groundwaters during winter freezeback under conditions of high hydraulic potential. Piezometers, installed in areas of active mound formation, indicate pressures ranging from 40 to 80 kPa are associated with mounds 1-2 m high.

2831 POULTON, T.P. - 1982
Paleogeographic and tectonic implications of the Lower and Middle Jurassic facies patterns in northern Yukon Territory and adjacent Northwest Territories; *in* Arctic Geology and Geophysics, eds. A.F. Embry and H.R. Balkwill, Can. Soc. Pet. Geologists, Memoir 8, pp. 13-27.

The stratigraphic relations in the Lower and Middle Jurassic rocks of northern Yukon and adjacent parts of Northwest Territories indicate deposition on a broad shelf trending northeast-southwest along the contemporary North American cratonic margin. Previous interpretations of a two-sided marine trough extending generally north-south across northern Yukon (i.e. Porcupine Plain - Richardson Mountains Trough) are not substantiated.

Re-examination of the stratigraphic evidence in northern Yukon and Alaska does not indicate the presence of a source-landmass in northern Alaska and northwestern Yukon (i.e. Keele-Old Crow Landmass) in Early and Middle Jurassic times. The first major supply from such a sediment source, in northern Alaska, is in the Late Jurassic. Northerly rather than southerly sources are indicated for older Jurassic rocks in northern Alaska.

Transcurrent movement in either direction on the Kaltag Fault can neither be supported nor rejected by the Jurassic record in northern Yukon. Hypotheses of counter-

clockwise rotation of northern Alaska away from Arctic Canada are not supported in view of the lack of volcanism in the Jurassic and Early Cretaceous of northern Yukon, i.e. in the proposed pivotal area of rotation of such hypotheses. The boreal character of Middle Jurassic marine faunas of northern Alaska firmly allies them with those of the Canadian Arctic.

2832 POULTON, T.P., and TEMPELMAN-KLUIT, D.J. - 1982
Recent discoveries of Jurassic fossils in the Lower Schist Division of central Yukon; *in* Current Research, Part C, Geol. Surv. Can., Paper 82-1C, pp. 91-94.

Recent discoveries of *Buchia* and *Cardioceras* species confirm the Jurassic age of the Lower Schist Division in central Yukon. The lithologies, sedimentary structures, and succession confirm the correlation of the Lower Schist with the Kingak Formation of northern Yukon. They further suggest the correlation of Keno Hill Quartzite of the North Klondike area with Neocomian quartzites of northern Yukon. The Keenan Quartzite of east-central Alaska, in a paleogeographic position between west-central and northern Yukon, must also represent the same unit.

2833 POULTON, T.P., LESKIW, K., and AUDRETSCH, A. - 1982
Stratigraphy and microfossils of the Jurassic Bug Creek Group of northern Richardson Mountains, northern Yukon and adjacent Northwest Territories; *Geol. Surv. Can.*, Bull. 325, 137 p.

The Bug Creek Group comprises the southeastern basin-marginal arenaceous facies of the Brooks-Mackenzie Basin during Sinemurian through early Oxfordian times. It is a northwesterly thickening wedge of shelf sandstones and siltstones that grades into a basinal shale facies of the Kingak Formation.

The Bug Creek Group is subdivided into the following new formations and members, in upward succession: Murray Ridge Formation (Sinemurian; argillaceous, with a basal conglomeratic sandstone, the Scho Creek Member); Almstrom Creek Formation (Pliensbachian approximately; sandstone); Manuel Creek Formation (Toarcian and Lower Bajocian; argillaceous; with a local sandstone, the Anne Creek Member); Richardson Mountains Formation (Middle Bajocian through early Oxfordian; argillaceous and sandstone facies; with a distinctive basal sandstone, the Little Bell Member; and a higher sandstone package, the Waters River Member); and Aklavik Formation (Early Oxfordian; sandstone). The sandstones are quartz-rich and contain abundant locally derived chert and siltstone fragments wherever they directly overlie Paleozoic rocks.

The Almstrom Creek and Aklavik Formations are two major sandstone units each probably storm-wave or tide-dominated, that prograded onto a shallow shelf and which represent regressive phases. Another regressive phase, without a significant sedimentary wedge is represented by the Manuel Creek Formation. This is associated with uplift and minor erosion of the basin margin.

The Bug Creek Group yields ammonites, bivalves, and other marine macrofauna locally, and a poorly preserved marine microbiota that is only locally prolific. Of this, 24 species of agglutinated foraminifera, 1 species of calcareous foraminifera, 1 species of ostracod, 1 species of radiolarian, 8 species of dinoflagellate, 7 species of spore or pollen, and 2 species of undifferentiated microplankton are figured, none as new species.

2834 POULTON, T.P. - 1984
The Jurassic of the Canadian western interior, from 49°N latitude to Beaufort Sea; *in* The Mesozoic of Middle North America, eds. D.F. Stott and D.J. Glass, Can. Soc. Pet. Geologists, Memoir 9, pp. 15-41.

The Jurassic shelf shales and sandstones of northern Yukon and adjacent Northwest Territories, including the subsurface Mackenzie Delta, are probably entirely derived from the craton to the south and southeast (Bug Creek Group; Kingak, Husky, North Branch, and Porcupine River Formations). The 'Lower Schist Division' of central Yukon is a southerly extension of the Kingak Shale of the north.

Phosphatic and cherty limestone and shale facies occur in the lower part of the Jurassic platform and miogeoclinal Fernie Formation of western Alberta and eastern British Columbia. Overlying Fernie units are dominantly shale with minor sandstones. Upper Jurassic sandstones of the lower Kootenay Group and lower Nikanassin and basal Monteith Formations record the change of sediment source from east to west resulting from early uplift of the Columbian Orogen and subsidence of the foredeep to its east.

Middle and Upper Jurassic shales, carbonates, evaporites, and sandstones (Watrous, Gravelbourg, Shaunavon, Vanguard and equivalent Formations) were deposited in a depositionally restricted epicratonic setting in the Williston Basin in southern Alberta, Saskatchewan and Manitoba. Early phases of the Columbian Orogeny are represented in the westernmost Williston Basin by the Upper Jurassic Swift Formation.

Similar transgressive-regressive events throughout the craton-related western Canadian Jurassic indicate unified tectonic and/or eustatic activity along the northwestern North American cratonic margin in Jurassic times. Greater sandstone developments in northern Yukon, and as yet poorly defined evidence in the Peace River area suggest more significant tectonic activity in the northern parts of the area than in the south.

The Jurassic rocks of Alberta, southern Saskatchewan and Manitoba are significant host rocks and source rocks for oil and gas deposits. Coal deposits are mined in Upper Jurassic beds of southwestern Alberta and southeastern British Columbia. Phosphates have been prospected in the Jurassic of southeastern British Columbia, and gypsum is mined in southern Manitoba.

2835 RETELLE, M.J. - 1985
Glacial geology and quaternary marine stratigraphy of the Robeson Channel area, northeastern Ellesmere Island, N.W.T., Canada; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 9-55.

Glacial and marine deposits associated with two phases of glaciation are exposed along a 60 km corridor on Ellesmere Island that borders Robeson Channel. The oldest sediments, tentatively dated at > 80,000 B.P. were deposited during a major advance of the northwest Greenland Ice Sheet across Robeson Channel. During subsequent retreat of this ice mass, glaciomarine sediments containing a high arctic macro- and microfauna, were deposited in the isostatic downwarp on Ellesmere Island. This marine unit was radiocarbon dated at 31,300 ± 900 and >32,000 B.P.; amino acid ratios (aIle/Ile) are 0.207 ± .02 and 0.062 for the free and total hydrolysate fractions.

The ice advance during the late Wisconsin to early Holocene did not extend into the field area from either interior Ellesmere Island or northwest Greenland. The ice marginal sea transgressed to the marine limit (ca. 116 m) and overlapped the deposits of the previous maximum Greenland advance. Local plateau ice caps did however, spill over into one major valley and delayed the establishment of the marine limit in this location. Radiocarbon dates on Holocene marine limit shorelines indicate initial emergence between 8000 and 8600 B.P. Amino acid ratios were not detectable in the free fraction and 0.037 ± .04 in the hydrolysate fraction.

Correlation of these units with other arctic sequences demonstrates similar early maximum ice extents and subsequently more restricted ice advances. The chronology for the Robeson Channel area supports a model for limited last ice extent that is non-synchronous with mid-latitude ice sheet expansion.

2836 RETELLE, M.J. - 1985
Late Quaternary stratigraphy and paleoenvironments of the Beaufort Lakes Basin, northeastern Ellesmere Island; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts, Contr. No. 49, pp. 57-106.

Late Quaternary environmental changes in a sedimentary basin on the coast of northeastern Ellesmere Island have been reconstructed using cores of sediment recovered from three contemporary lakes. The lake basins were isostatically depressed below sea-level in an ice-free corridor between ice sheets over northwest Greenland and Ellesmere Island during the last glaciation. They became isolated from the sea as the two ice sheets retreated and the coast isostatically readjusted to the reduced ice load. Each sediment core recovered comprised lacustrine sediments overlying glaciomarine sediments. Sedimentary properties such as grain size, loss-on-ignition, porewater geochemistry and faunal content were determined to characterize changes in the depositional environment from 'full glacial' to modern lacustrine conditions.

2837 RICKETTS, B.D. - 1985
Volcanic breccias in the Isachsen Formation near Strand Fiord, Axel Heiberg Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 85-1A, pp. 609-612.

An 80 m thick sequence of volcanic breccia occurs in the upper Isachsen Formation at the northeast end of Strand Fiord. Most of the sequence consists of non-stratified, angular, nonsorted basalt breccia. These massive breccias originated when rising magma reacted with meteoric water at very shallow burial depths, and were subsequently extruded as breccia onto the Isachsen delta plain. A different origin is envisaged for the crudely stratified and matrix-supported breccias that occur in the upper few metres of the sequence. They are probably lahars that reworked the extruded breccia and small amounts of included bedrock.

2838 ROBERTSON, P.B., COLEMAN, L.C., OLSEN, E.J., and KISSIN, S.A. - 1982
Canadian Arctic meteorite search: 1981; *Meteoritics*, vol. 17, no. 3, pp. 163-170.

The recovery of several thousand meteorite fragments from Antarctica has led to speculation that accumulations may occur on the Earth's other major ice caps. Meteorites falling over the past 80,000 years on the Devon Island ice cap in the Canadian Arctic may be exposed at the surface near the ice cap margin. From the terrestrial meteorite flux, ice movement rates, and fragmentation factors it is calculated that 12,560 samples of 150 g mass are potentially concentrated in a 65 km^2 zone along the northwest margin. A search of this region on foot and by helicopter in July, 1981, failed to recover any specimens. Although metre-sized gneissic boulders, plucked from the underlying Precambrian basement, were concentrated in this zone it is postulated that the unseasonal 30 cm snow cover on the ice prohibited the recognition of possible meteorite specimens, which may average only 5 cm in diameter.

2839 ROBERTSON, P.B., and SWEENEY, J.F. - 1983
Haughton impact structure: structural and morphological aspects; *Can. J. Earth Sci.*, vol. 20, no. 7, pp. 1134-1151.

Haughton is a complex meteorite impact structure of Tertiary age on Devon Island in the Canadian Arctic. The 20.5 km diameter site was formed in essentially flat-lying Paleozoic carbonates, roughly 1700 m in thickness, overlying Precambrian gneisses. The structure comprises three concentric rings surrounding a central basin with interior peaks. The outer ring, diameter 20.5 km, is an annulus of peaks separating the Allen Bay dolomites of the regional plateau from the same unit that has been downdropped towards the crater interior along a series of circumferential faults. The middle ring of peaks, diameter 14-15 km, comprises both faulted Allen Bay dolomites and blocks of the underlying Bay Fiord Formation uplifted 250 m. Hills of the inner, elliptical ring, 3.5 - 5.5 km in diameter, are also formed from Bay Fiord Formation and the underlying Eleanor River Formation brought up 600 m. An interconnected series of normal faults occupies most of the annulus between the inner and outer rings. Within the central basin occur isolated hills of Bay Fiord and Eleanor River material, again raised a minimum of 700 m. Allochthonous impact breccia, containing shocked clasts of all sedimentary units and the Precambrian crystalline rocks, covers most of the central basin and the inner ring, and occurs in patches within the faulted annulus. A circular, - 11

mGal (- 11 x 10^{-5}m s^{-2}) residual Bouguer gravity anomaly, diameter 25 km, is concentric with the structure. A more intense central "low" is tentatively correlated with allochthonous breccia up to 200 m in thickness. A 300 nT positive magnetic anomaly is situated at the crater's centre and possibly reflects the near-surface occurrence of crystalline rocks of the uplifted Precambrian basement. Most of the structural and morphological features at Haughton have counterparts in the thoroughly investigated Ries impact structure, Germany, and the allochthonous breccia is considered equivalent to the suevite deposits of the latter site.

The transition between various morphologies in the crater populations of the cratered planets is a function of size, rock type, and planetary gravity. Scaling from lunar data indicates that a *multi-ring impact basin* in sedimentary rocks may form on Earth at a diameter not much larger than that of Haughton. The morphology of Haughton is considered intermediary between *peak ring basins* and *multi-ring basins*.

2840 ROBSON, M.J. - 1985
Lower Paleozoic stratigraphy of northwestern Melville Island, District of Franklin; *in* Current Research, Part B, Geol. Surv. Can., Paper 85-1B, pp. 281-284.

The Lower Paleozoic succession in the Canrobert Hills comprises three formations: the Canrobert, the Ibbett Bay and the Blackley.

The resedimented carbonate rocks of the Canrobert Formation (Upper Cambrian? to Lower Ordovician) are interpreted as slope deposits. They are overlain by black shales and cherts of the Ibbett Bay Formation which ranges in age from the early Ordovician to Middle Devonian, and is interpreted as a deep water basinal deposit. Above the Ibbett Bay, the Blackley Formation, comprising siltstones, mudrocks, and turbidite packages forms the local base of the Middle Devonian clastic wedge that represents the closing phase of sedimentation in the Franklinian Geosyncline.

2841 ROHR, D.M., and PACKARD, J. - 1982
Spine-bearing gastropods from the Silurian of Canada; *J. Paleontology*, vol. 56, no. 2, pp. 324-334.

Four gastropods bearing long peripheral spines are made known from the Upper Silurian of Canada: *Spinicharybdis wilsoni* n. gen., n. sp., *S. billingsi* n. sp., and *S. canteriata* n. sp. occur in the Barlow Inlet Formation, Cornwallis Island, Arctic Canada; and *?Spinicharybdis elora* (Billings, 1865) occurs in the Guelph Formation, Ontario. All four species are characterized by long hollow spines which are interpreted to have supported the shell above the substrate during the organism's mostly sedentary life. *Spinicharybdis* is thought to have lived in moderately shallow, subtidal environments on a firm substrate.

2842 SCHWERDTNER, W.M., and VAN KRANENDONK, M. - 1984
Structure of Stolz Diapir - a well-exposed salt dome on Axel Heiberg Island, Canadian Arctic Archipelago; *Bull. Can. Pet. Geology*, vol. 32, no. 2, pp. 237-241.

The Stolz Diapir has an average horizontal diameter of 1.2 km and is much smaller than the large oval domes of the western Sverdrup Basin. It is the only salt dome known in Canada whose internal structure can be viewed in magnificent outcrops.

Well-jointed rock salt is exposed on subvertical cliffs in the western quadrant of the diapir, where the hood of gypsified anhydrite has been breached by a large seasonal stream. The subvertically bedded rock salt, locally thrown into tight minor folds, is separated from the moderately dipping bedded anhydrite by a few metres of white, poorly compacted residue of dissolved halite. The residue is composed mostly of sulphates.

Coarse rock salt, with maximum crystal dimensions of more than 20 cm, is well preserved in outcrops, whereas fine-grained salt has lost most of its cohesion. Even on vertical outcrop surfaces, the irregular boundaries of large halite crystals have been accentuated by incipient weathering. The lobate shapes of the subequant crystals resemble those in the salt domes of the American Gulf Coast.

2843 SCHWERDTNER, W.M. - 1985
Gypsum-Anhydrite Caps of Arctic Salt Domes, Queen Elizabeth Islands: Products of Active and Passive Diapirism; *in* Proc. Sixth Intern. Sym. on Salt, May 24-28, 1983, Toronto, Canada, Vol. 1, Salt Institute, pp. 311-314.

Unlike the salt-dissolution caps of classical salt stocks in northern Germany and Texas-Louisiana, the stratified gypsum-anhydrite caps of the Arctic domes are made of metasedimentary anhydrite with limestone interbeds. This strange type of cap is structural rather than chemical in origin. Its formation requires that, at the onset of diapirism, the $CaSO_4$ material behaves actively like a ductile buoyant medium, and gives rise to incipient salt-anhydrite domes. Such behaviour can be expected of an anhydrite mush produced by dehydration of primary gypsum and leads to a mechanical concentration of $CaSO_4$ material above low-amplitude salt domes. The anhydrite mush proceeds to lose water during continued diapirism and rapidly changes into dense imporous anhydrite. The resulting competent cap has most mechanical attributes of a salt-dissolution cap and acts like a semi-brittle battering-ram which passively pierces the overlying sedimentary strata while being driven by a growing dome of buoyant rock salt.

2844 SCOTTER, G.W. - 1985
A Pingo in the Mala River Valley, Baffin Island, Northwest Territories, Canada; *Arctic*, vol. 38, no. 3, pp. 244-245.

A single pingo is located on an alluvial fan within the deeply incised Mala River valley of the Borden Peninsula, Baffin Island. Its formation appears to be related to the abandonment of the river channel due to the influx of alluvium from a tributary stream.

2845 SHARPE, D.R. - 1984
Late Wisconsinan glaciation and deglaciation of Wollaston Peninsula, Victoria Island, Northwest Territories; *in* Current Research, Part A, Geol. Surv. Can., Paper 84-1A, pp. 259-269.

Detailed study of glacial landforms has allowed a sequence of ice retreat maps to be produced for Wollaston Peninsula showing frontal and/or areal stagnation of full ice cover. Frontal retreat consists of a sequence of end moraine fragments and ice marginal outwash terraces and fans that can be traced across central Wollaston Peninsula. These features indicate that free drainage occurred to the west coast during this frontal retreat. Little evidence exists for damming of glacial meltwater.

2846 SHARPE, D.R. - 1985
The stratified nature of deposits in streamlined glacial landforms on southern Victoria Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can. Paper 85-1A, pp. 365-371.

The structure of streamlined landforms near Cambridge Bay, Northwest Territories, suggests that these major glacial deposits may be produced by deposition from subglacial meltwater. Fluted landscapes are spatially gradational to drumlin features, which in turn are transitional to large eskers, all comprising stratified deposits including interbedded sand and diamicton. These sediments are intact, interbedded, and conformable with the landform, and they probably represent accumulation in a subaqueous environment. Both drumlinoid and fluted forms could result from meltwater eroding subglacial cavities that were subsequently filled with sediment from the meltwater and from the glacier.

The implications of the proposed meltwater origin of streamlined landforms are that landform-sediment descriptions are crucial to mapping glacial sediments and that interpretation of the glacial geology and sediments of many areas needs to take into account the significance of subglacial meltwater deposition.

2847 SMITH, G.P., and STEARN, C.W. - 1982
The Devonian carbonate-clastic sequence on southwest Ellesmere Island, Arctic Canada; *in* Arctic Geology and Geophysics, eds. A.F. Embry and H.R. Balkwill, Can. Soc. Pet. Geologists, Memoir 8, pp. 147-154.

Measurements of numerous stratigraphic sections, coupled with published information, indicate that the Devonian Blue Fiord and Bird Fiord formations are a prograding carbonate sequence which grades upward into the silici-clastics of the Okse Bay Group.

The Blue Fiord Formation in the type area exhibits the following succession of lithofacies upwards in the stratigraphic column: (a) carbonate buildups, rich in *Alveolites* and other corals, isolated in the Hazen Trough, with associated brachiopod-rich (*Cypidula-Atrypa-Schizophoria* biofacies) limestones; (b) deep and/or quiet water, poorly fossiliferous, black shales, and limemudstone of the "back-reef" basin (connected with Hazen Trough), with associated calciturbidite beds; and (c) platform and platform margin coral wackestones and crinoidal grainstones.

Conformably overlying the Blue Fiord Formation is the Bird Fiord Formation, which is composed of limestones with coral-rich beds, and calcareous shales, probably deposited on, or at the edge of, a carbonate platform. At the top of this formation are interbedded shales, limestones, and sandstones deposited in a deltaic environment.

The succession ended with Middle Devonian deltaic siltstone, sandstone, and shale of the lower Okse Bay Group overlain by alternating sandstones and shales of fluvial origin. This marked the end of deposition in the Franklinian Basin.

Progradation started in the Early Devonian, probably caused by a decrease in the rate of subsidence and/or an increased rate of carbonate sedimentation. By Middle Devonian time, relative uplift had taken place, and a land area was supplying the clastic sediments of the Bird Fiord Formation, and the Okse Bay Group.

The inferred distribution of the facies in Early and Middle Devonian time implies a direction of progradation towards the north and west from a land area situated in northern Devon Island and eastern Ellesmere Island. In the late Middle and Late Devonian, the composition of clastic strata and paleocurrent data from fluvial sediments suggest a source east of the basin (eastern part of Canadian Shield, or western Greenland Shield).

2848 SOBCZAK, L.W. - 1982
Fragmentation of the Canadian Arctic Archipelago, Greenland, and surrounding oceans; *in* Nares Strait and the drift of Greenland: a conflict in plate tectonics, eds. P.R. Dawes & J.W. Kerr, Meddr. Grønland, Geosci., vol. 8, pp. 221-236.

Fragmentation of the Canadian Arctic Archipelago, Greenland and surrounding ocean basins is indicated mainly by a pattern of northeast-trending fractures and northwest-trending arches and rifts. Based on a comparison of this structural pattern with experimentally produced fracture patterns, a new evolutionary concept for the Cenozoic era is proposed for the region. The Eurasia Basin and North Atlantic sea-floors developed as rift-generated tensional zones separated by a later developed dextral transform shear zone, here named the Nansen Shear Zone. Sub-parallel to and some 2000 km southwest of this shear couple is another less well-developed system comprised of M'Clure Strait and Baffin Bay which were initiated by rifting and later connected by a dextral transform shear zone, here named the Parry Channel Shear Zone. The landmass between these two transform couples (Greenland and the Queen Elizabeth Islands) probably was and is acted upon by a sinistral force couple as a result of spreading between these couples and is probably partially responsible for generating internal deviatoric tensional and compressional stresses noted from earthquake data. Fractures and arch axes within the Queen Elizabeth Islands have similar directions to respective features within the North Atlantic sea-floor; stresses may have similar orientations in both regions.

Nares Strait may be a poorly-developed sinistral transform shear zone that joins rift-generated ocean basins: the Eurasia Basin to the north and Baffin Bay to the south.

2849 STEWART, T.G., and ENGLAND, J. - 1983
Holocene sea-ice variations and paleoenvironmental change, northernmost Ellesmere Island, N.W.T., Canada; *Arctic & Alpine Res.*, vol. 15, no. 1, pp. 1-17.

More than 70 samples of Holocene driftwood between present sea level and the marine limit are plotted on an emergence curve from Clements Markham Inlet (82°40'N). Three periods of driftwood abundance and sparsity are recognized. These are interpreted as indications of climatically induced changes in summer sea ice conditions. Period 1 extends from initial driftwood entry ca. 8900 BP until ca. 4200 BP. During this period driftwood penetration increases with greatest abundance (= reduced summer sea ice) ca. 6000 to 4200 BP. During Period 2 (ca. 4200 to 500 BP) driftwood penetration is sparse whereas in Period 3 (< 500 BP) driftwood bordering the present shoreline exceeds all the samples in the previous periods. Driftwood dates from elsewhere in the Canadian and Greenland High Arctic show similar periods.

In Clements Markham Inlet the initiation of abundant driftwood penetration corresponds with the deposition in marine sediments of fossil bryophytes (25 species) dated 6400 BP. This increased plant productivity is also interpreted as indicating summer warmth/higher precipitation associated with the greater open water. Accompanying these bryophytes is the disjunct marine pelecypod *Limatula (Lima) subauriculata* which presently has a subarctic-boreal distribution. This paleoenvironmental information is discussed in relation to Holocene ice core records and the history of Arctic Ocean sea ice stability.

2850 STEWART, W.D., and KERR, J.W. - 1985
Geology, Somerset Island North, District of Franklin; *Geol. Surv. Can.* List No. 941, Map 1595A, Scale 1:250 000.

2851 STEWART, W.D., and KERR, J.W. - 1985
Geology, Somerset Island South, District of Franklin; *Geol. Surv. Can.* List No. 941, Map 1596A, Scale 1:250 000.

2852 STEWART, W.D., and KERR, J.W. - 1985
Geology, Boothia Peninsula North, District of Franklin; *Geol. Surv. Can.* List No. 941, Map 1597A, Scale 1:250 000.

2853 STEWART, W.D., and KERR, J.W. - 1985
Geology, Central Boothia Peninsula, District of Franklin; *Geol. Surv. Can.* List No. 941, Map 1598A, Scale 1:250 000.

2674 SWEENEY, J.F. - 1984
Arctic Tectonics - What We Know Today; *GEOS*, E.M.& R., vol. 13, no. 4, pp. 8-10. *CESAR Contr. No. 3.*

2854 SWEENEY, J.F. - 1985
Comments about the age of the Canada Basin; *Tectonophysics*, vol. 114, pp. 1-10.

The Canada Basin appears to have formed over a 60 Ma interval during the Cretaceous period. The opening process can be divided into two parts: continental breakup, widespread in Hauterivian through Aptian time (about 131-113 Ma ago) along what was about to become the polar margin of North America, and seafloor formation active during the extended Cretaceous interval of normal geomagnetic polarity to marine magnetic anomaly 33 time (about 118-79 Ma ago). Presently available age controls indicate that all parts of the North American polar margin could have formed at about the same time. Two styles of margin formation are evident. From Brock to Axel Heiberg Island there appears to be an extended (70 Ma) stratigraphic hiatus and, northeastward from Ellef Ringnes Island, extensive tholeiitic igneous activity associated with continental breakup. From Banks Island to northeastern Alaska the breakup interval is abbreviated (20-30 Ma) and few igneous rocks are observed. A progressive difference may be indicated in the amount and/or rate of crustal stretching during margin formation, with relatively less/slower stretching having occurred along the segment southwest of Brock Island and relatively more/faster stretching having taken place along the segment to the northeast.

2855 SYVITSKI, J.P.M., and BLAKENEY, C.P. - 1983
Sedimentology of Arctic Fjords Experiment: HU 82-031 Data Report, Volume 1; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci. No. 12, 935 p.

This is the first in a series on the Sedimentology of Arctic Fjords Experiment (Geological Survey of Canada project 810042). The data are reported in 20 chapters: 35 scientists participated in the project.

2856 SYVITSKI, J.P.M. - 1984
Sedimentology of Arctic Fjords Experiment: HU 83-028 and HU 82-031 data report, Volume 2; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci. No. 28, 1130 p.

This is the second series of reports on the "Sedimentology of Arctic Fjords Experiment". Some 40 scientists from different organizations participated in the project. The data they collected have been organized into 20 chapters and includes information on: synoptic oceanography, suspended particulate matter, benthos, boulder transport due to algae, geochemistry, geotechnical properties, grab and core samples, high resolution deep tow seismic profiles, sidescan sonar profiles, land surveys, instrument moorings, weather, heavy minerals and hydrography.

2857 TAYLOR, R.B., and McCANN, S.B. - 1983
Coastal depositional landforms in northern Canada; *in* Shorelines and Isostasy, eds. D.E. Smith and A.G. Dawson, Inst. British Geographers Special Pub. No. 16, Academic Press, pp. 53-75.

In Canada research on sea ice related processes has ranged through 30° of latitude, from the Gulf of St. Lawrence to the Arctic Ocean, encompassing a wide variety of ice environments and ice effects which range from negligible to overwhelming. Though we have been concerned with the special role of ice, we have always worked within the framework of general shoreline dynamics, recognizing that, in many locations, ice is merely an additional, rather than a dominant, variable in the system and that the long-term coastal evolution at most of our research sites is dominated by isostatic emergence.

In many instances the suites of elevated coastal landforms are much more impressive than the modern shoreline features.

2858 TAYLOR, R.B., and FROBEL, D. - 1984
Coastal surveys, Jones Sound, District of Franklin; *in* Current Research, Part B, Geol. Surv. Can., Paper 84-1B pp. 25-32.

In 1983, low-altitude video tapes were made of the coast of Jones Sound; launch surveys were completed off five tidewater glaciers along the northeast coast of Devon Island. Large submarine glacial deposits off northeast Devon Island suggest that some of the valley glaciers once stood 2 to 7 km offshore for a considerable time before rapidly retreating to near their present position. Today, the proglacial tidewater environments in bays resemble those of the slowly retreating shallow-water glaciers in Glacier Bay, Alaska. Most of the Devon Island tidewater glaciers are grounded and are fringed by an ice-proximal shelf. Ice-front thickness is commonly 55 to 76 m but at the face of larger glaciers, it exceeds 100 m. Sediment gravity flows, observed across the ice-proximal shelf foreslope, are an important agent in the transfer and deposition of sediment in the proglacial basins.

2859 TAYLOR, R.B., and FROBEL, D. - 1985
Videotapes of the coastline of Jones Sound, N.W.T.; *Geol. Surv. Can.* List No. 933, Open File No. 1079.

This open file consists of a twenty minute introduction to the coastal environment of Jones Sound and seven one hour 3/4" video tapes illustrating the coastline.

Location maps and field commentary on the physical shore zone character and coastal sea ice are included on the tapes.

2860 THORSTEINSSON, R. - 1984
A sulphide deposit containing galena, in the lower Devonian Disappointment Bay Formation on Baillie Hamilton Island, Canadian Arctic Archipelago; *in* Current Research Part B, Geol. Surv. Can., Paper 84-1B, pp. 269-274.

Baillie Hamilton Island is situated in a region noted for lead and zinc deposits similar in many respects to the Mississippi Valley-type ore deposits. A sulphide deposit that includes small amounts of galena occurs in porous and vuggy dolomite of the Disappointment Bay Formation near the southwestern extremity of Baillie Hamilton Island. Mineralized deposits are rare in the Disappointment Bay Formation, and the present deposit adds further interest to this formation as a potential host for lead and zinc ore bodies. Most lead and zinc occurrences in this region of the archipelago, including that of the currently operated Polaris Mine, are replacement deposits in carbonate rocks of the Ordovician Thumb Mountain Formation that were exposed to erosion and karstification in Early Devonian time, and subsequently overlain unconformably by the Disappointment Bay Formation. Structural evidence is presented here that suggests the Disappointment Bay in southwestern Baillie Hamilton Island may lie directly on the Thumb Mountain. This in turn raises the possibility, however tenuous, that the sulphide deposit in that region indicates the presence of an ore body at depth in Thumb Mountain strata.

2861 TIMPERLEY, M.H., and JONASSON, I.R. - 1982
Chemical forms of copper in fallen snow; *in* Current Research, Part C; Geol. Surv. Can., Paper 82-1C, p. 103.

2862 TRETTIN, H.P., MAYR, U., and EMBRY, A.F. - 1982
Preliminary geological map and notes, part of Lady Franklin Bay map area, District of Franklin (NTS 120C); *Geol. Surv. Can.*, Open File No. 834, GSC List No. 901.

2863 TRETTIN, H.P. - 1982
Lower Paleozoic geology in parts of Greely Fiord East, Greely Fiord West and Canon Fiord map areas, District of Franklin (NTS 340A,B, 49H); *Geol. Surv. Can.*, Open File No. 836, GSC List No. 901.

2864 TRETTIN, H.P., LOVERIDGE, W.D., and SULLIVAN, R.W. - 1982
U-Pb ages on zircon from the M'Clintock West massif and the Markham Fiord pluton, northernmost Ellesmere Island; *in* Rb-Sr and U-Pb Isotopic Age Studies, Report 5, *in* Current Research, Part C, Geol. Surv. Can., Paper 82-1C, pp. 161-166.

Zircon from a small granitic sheet within the M'Clintock West massif, a mafic-ultramafic complex of ophiolitic aspect, yields a U-Pb concordia intercept age of 481 + 7/-6 Ma which suggests seafloor spreading in the late Early Ordovician (Arenig). Zircon from the granitic Markham Fiord pluton has a concordia intercept age of 462 ± 11 Ma. This intrusion probably crystallized during the subsequent collisional orogeny in the early Middle Ordovician, no later than in early Black River time (earliest Caradoc).

2865 UTTING, J. - 1985
Preliminary results of palynological studies of the Permian and lowermost Triassic sediments, Sabine Peninsula, Melville Island, Canadian Arctic Archipelago; *in* Current Research, Part B, Geol. Surv. Can., Paper 85-1B, pp. 231-238.

Well preserved palynomorphs have been found in samples from the uppermost part of the Canyon Fiord Formation (Lower Permian?); the Belcher Channel (Lower Permian), Sabine Bay (Lower Permian), and Assistance (Lower Permian) formations; "Unit A" (Lower or Upper Permian); and the Trold Fiord (Upper Permian) and lower Bjorne (Lower Triassic) formations. Pollen and spores occur in all formations, and acritarchs in all except the Canyon Fiord and Bjorne. In general terms, the Permian assemblages contain abundant, striate disaccate pollen (Protohaploxypinus spp.), polyplicate pollen (*Vittatina* spp. and *Weylandites* spp.), and trilete spores. Monosaccate pollen (*Cordaitina* spp.) occurs occasionally. The Lower Triassic assemblages contain abundant striate disaccate pollen (*Protohaploxypinus* spp. and *Taeniaesporites* sp[illegible], non-striate disaccate pollen (*Falcisporites* sp. and *Klausipollenites* spp.), colpate pollen (*Gnetaceaepollenites* spp.), and trilete spores (*Kraeuselisporites* spp. and *Lundbladispora* spp.). Present also

is the cyst-like microfossil *Tympaniocysta stoschiana*. The assemblages are unlike those of Gondwana and Cathaysia. They appear to be more similar to those described from the northeast European part of Russia than those of Western Europe.

The Thermal Alteration indices of the palynomorphs are low (2- to 2+ on a five point scale), suggesting suitable conditions for the generation of liquid hydrocarbons.

2866 van BERKEL, J.T., HUGON, H., SCHWERDTNER, W.M., and BOUCHEZ, J.L. - 1983
Study of anticlines, faults and diapirs in the central Eureka Sound Fold Belt, Canadian Arctic Islands: preliminary results; *Bull. Can. Pet. Geology*, vol. 32, no. 2, pp. 109-116.

Detailed geological mapping was carried out in a major fault zone and two large anticlines of the Central Eureka Sound Fold Belt, eastern Axel Heiberg Island, Canadian Arctic. All these structures contain evaporite diapirs with minimum horizontal diameters between 300 m and 4 km. The sense of bedding-parallel shear in the limbs of the anticlines is opposite to that of buckle folds formed by horizontal compression. Thus the anticlines may be clastic hoods of pre-Eurekan salt-walls rather than Eurekan compression folds. The main branch of the fault zone (Stolz Thrust) seems to have numerous lateral ramps or to be offset by short tear faults. Apart from equant to oval evaporite diapirs, the main branch of this fault zone contains long conformable masses of gypsum-anhydrite (Carboniferous Otto Fiord Formation) whose limestone interbeds are thrown into complex folds. The asymmetry of folding is compatible with the large-scale thrusting and thin-skinned tectonics of the Eurekan Orogeny.

2867 van BERKEL, J.T., SCHWERDTNER, W.M., and TORRANCE, J.G. - 1984
Wall-and-basin structure: an intriguing tectonic prototype in the central Sverdrup Basin, Canadian Arctic Archipelago; *Bull. Can. Pet. Geology*, vol. 32, no. 4, pp. 343-358.

The Strand Bay region of western Axel Heiberg Island is characterized by crooked walls of diapiric anhydrite contained in folded clastic rocks. The diapirs are cores of narrow anticlines situated between rhomboidal to polygonal to crudely oval synclines. This style of deformation is unique on Axel Heiberg Island and perhaps even in the Sverdrup Basin.

Geometric analysis shows that most of the wall segments strike N-S or WNW-ESE. The diapirs may have risen along two sets of vertical fractures generated by lateral pull of the hanging-wall block of the crooked Stolz thrust (eastern Axel Heiberg Island). Alternatively, anhydrite walls could be the extruded cores of buckle folds formed upon a zone of *décollement* (Carboniferous salt). Successive buckle folding seems to be required, in subperpendicular directions, to obtain the geometric pattern of evaporite walls and oval synclines, herein named wall-and-basin structures (WABS), in the Strand Bay region. Solution of this problem will have important implications for the mechanics of pre-Eurekan halokinesis and Eurekan tectonism on western Axel Heiberg Island.

2675 VAN WAGONER, N.A., and ROBINSON, P.T. - 1984
Petrography and geochemistry of the CESAR "Hard Rock": Possible implications for the origin of the Alpha Ridge; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 87.

2676 VAN WAGONER, N.A., and ROBINSON, P.T. - 1985
Petrology and geochemistry of a CESAR bedrock sample: implications for the origin of the Alpha Ridge; *Geol. Surv. Can.*, Paper 84-22, pp. 47-57. *CESAR Contr. No. 12.*

2677 VAN WAGONER, N.A., and WILLIAMSON, M.C. - 1985
Tectonic Evolution of the Alpha Ridge: Geochemical Constraints; *Abstract in, Geophysics*, vol. 50, no. 8, p. 1363. Presented at CSEG/CGU Convention.

2868 VEILLETTE, J., and NIXON, M. - 1980
The development and use of lightweight equipment; *Northern Development*, Jan./Feb., pp. 21-23.

Scientific research in the North has increased with Arctic gas and oil exploration during the last twenty years. The Terrain Sciences Division of the Geological Survey of Canada has made its own contribution to this scientific endeavour, producing maps describing the distribution of superficial formations in sectors which seemed most likely to be affected by construction activities.

One of the fundamental objectives was to incorporate on these maps an assessment of the physical and geotechnic properties of deposits. From the outset it was clear that serious technical problems would have to be overcome in identifying the presence of ice in the permafrost and in ascertaining its distribution and quantity. The drills which were in common use were more often than not poorly adapted to shallow work (10 m or less). Economic constraints and limitations respecting transport also had to be dealt with, since the latter was often effected by helicopter or light aircraft.

This article outlines the results of a project aimed at improving the techniques and equipment used for drilling in frozen soils and upgrading the efficiency of light equipment of the sort which can be carried in a back-pack or by helicopter. For this purpose, a portable power auger and a unit consisting of a drill mounted on an all-terrain vehicle (ATV drill) were developed.

2869 VINCENT, J.-S. - 1982
The Quaternary history of Banks Island, N.W.T., Canada; *Géographie physique et Quaternaire*, vol. XXXVI, nos. 1-2, pp. 209-232.

Banks Island is a polar desert where continental ice sheets, spreading from a dispersal centre to the southeast, reached their maximum extent on at least three occasions. The oldest Banks Glaciation affected all but the northwest. The Pre-Banks Sea preceded glacierization while the Post-Banks Sea formed during deglaciation. Following Morgan Bluffs Interglaciation, characterized by a climate similar to that of today, the south, the east, and the Thomsen River basin were covered during

Thomsen Glaciation. The Pre-Thomsen Sea preceded the glacierization, while the Big Sea inundated much of the Island during deglaciation. Following the last or Cape Collinson Interglaciation, characterized by a climate warmer than that of the hypsithermal, Laurentide glacial lobes impinged on the coastal areas, during the M'Clure Stade of Amundsen Glaciation. Prince of Wales and Thesiger lobes, emanating from Amundsen Gulf, respectively advanced in Prince of Wales Strait and Thesiger Bay impinging on the east and southwest coasts. At the same time, Prince Alfred Lobe, originating in Viscount Melville Sound, advanced in M'Clure Strait and impinged on the north coast. The Pre-Amundsen Sea preceded the glacierization of the south coast, while the East Coast Sea submerged the east coast up to 120 m, the Meek Point Sea the west up to 20 m, and the Investigator Sea the north up to 30 m, during deglaciation. The late Sand Hills Readvance of Thesiger lobe built a morainic system on the southwest coast. Later, the northeast was covered, during the Russell Stade of Amundsen Glaciation, by Viscount Melville Lobe, emanating from Viscount Melville Sound, and the east coast was drowned up to 25 m by the Schuyter Point Sea. Limits of extent of Laurentide ice in the southwestern Archipelago are proposed for the two stades of the last or Wisconsinan Glaciation.

2870 VINCENT, J.-S. - 1983
Les Lacs Glaciaires de l'île de Banks, arctique canadien; *Géographie physique et Quaternaire*, vol. XXXVII, no. 1, pp. 39-48.

La cartographie des formations superficielles de l'île de Banks a permis de reconnaître l'existence de douze lacs glaciaires. Ceux-ci sont associés à l'un ou l'autre des trois glaciers continentaux qui ont atteint leur limite d'extension sur l'île au cours du Quaternaire. Les lacs ont été piégés dans des régions non englacées sises à la bordure des inlandsis ou se sont étendus sur des régions nouvellement libérées des glaces. Les lacs Egina et Storkerson ont inondé des surfaces au nord-ouest lors du retrait des glaces au cours de la plus ancienne Glaciation de Banks. Les lacs Parker et Dissection ont submergé des régions non englacées du plateau du nord-est lors de la Glaciation de Thomsen, antérieure au dernier interglaciaire. Au cours du Stade de M'Clure de la Glaciation d'Amundsen (Wisconsinien inférieur), huit lacs ont été piégés dans des vallées en bordure des lobes de Thesiger, de Prince of Wales et de Prince Alfred qui étaient ancrés dans les bras de mer entourant l'île. Les lacs glaciaires ont fourni, en se basant sur leur localisation et sur celle de leurs exutoires, des renseignements sur le mode de déglaciation et sur la direction du retrait des glaces. Dans le cas des lacs associés au Stade de M'Clure, les liens entre ceux-ci et les divers lobes glaciaires ont permis de démontrer qu'il y avait une correspondance d'âge entre les lobes de Thesiger, de Prince of Wales et de Prince Alfred.

2871 VINCENT, J.-S. - 1983
La géologie du Quaternaire et la géomorphologie de l'île Banks, arctique canadien; *Commission Géologique*, Mémoire 405, 118 p.

L'île Banks, sise en bordure du continent nord-américain, est un désert polaire où une longue suite d'événements quaternaires sont préservés et où inlandsis continentaux venant d'un centre de dispersion au sud-est ont atteint au moins à trois reprises leur extension maximale. La plus vieille et la plus puissante Glaciation de Banks a submergé toute l'île sauf le nord-ouest. La Mer glacio-isostatique Pré-Banks a précédé l'englaciation tandis que la Mer Post-Banks et les lacs glaciaires Egina et Storkerson ont existé lors de la déglaciation. Après l'Interglaciaire de Morgan Bluffs, marqué par un climat semblable à celui qui existe aujourd'hui, le sud, l'est et le bassin de la rivière Thomsen, dans le centre nord, ont été submergés par les glaces au cours de la Glaciation de Thomsen. Les lacs glaciaires Parker et Dissection ont existé dans le nord-est. La Mer Pré-Thomsen a précédé l'englaciation, tandis que la Mer Big a submergé de vastes régions lors de la déglaciation. Suite au dernier Interglaciaire de Cape Collinson, marqué par un climat un peu plus chaud que celui de l'hypsithermal, des lobes de glace laurentidiens ont empiété sur les régions côtières de l'île, au cours du Stade de M'Clure de la Glaciation d'Amundsen au Wisconsinien inférieur. Les lobes de Prince of Wales et de Thesiger, émanant du golfe Amundsen, ont respectivement progressé, l'un vers le nord-est dans le détroit du Prince-de-Galles, empiétant sur la côte est de l'île, l'autre vers le nord-ouest, empiétant sur la côte sud-ouest de l'île. Au même moment, le Lobe de Prince Alfred, émanant du détroit du Vicomte-Melville, a progressé vers l'ouest dans le détroit de M'Clure en empiétant sur la côte nord. Les lacs glaciaires Sarfarssuk, Cardwell et De Salis ont été retenus au front du Lobe de Prince of Wales, les lacs Masik, Rufus et Raddi, au front du Lobe de Thesiger et les lacs Ballast et Ivitaruk, au front du Lobe de Prince Alfred. La Mer Pré-Amundsen a précédé l'englaciation de la côte sud, tandis que la Mer d'East Coast a submergé l'est de l'île jusqu'à 120 m, la Mer de Meek Point, l'ouest jusqu'à 20 m et la Mer Investigator, le nord jusqu'à 30 m, lors de la déglaciation. Un complexe morainique a été édifié sur la côte sud-ouest par l'avancée tardive de Sand Hills du Lobe de Thesiger. Après une période interstadiaire, la pointe nord-est de l'île a été recouverte par le Lobe de Viscount Melville, émanant du détroit du Vicomte-Melville, lors du Stade de Russell de la Glaciation d'Amundsen au Wisconsinien supérieur, et la côte est a été submergée jusqu'à 25 m par la Mer de Schuyter Point. L'auteur décrit et nomme les sédiments mis en place au cours de ces événements, établit leur stratigraphie et suggère enfin les limites d'avancée du glacier laurentidien, dans le sud-ouest de l'archipel Arctique, au Wisconsinien inférieur et supérieur.

2872 VINCENT, J.-S., OCCHIETTI, S., RUTTER, N., LORTIE, G., GUILBAULT, J.-P., and de BOUTRAY, B. - 1983
The late Tertiary - Quaternary stratigraphic record of the Duck Hawk Bluffs, Banks Island, Canadian Arctic Archipelago; *Can. J. Earth Sci.*, vol. 20, no. 11, pp. 1694-1712.

The Duck Hawk Bluffs, of southwestern Banks Island in the Canadian Arctic Archipelago, record a succession of late Tertiary-Quaternary events. Organic-bearing sediments of eolian, fluvial, and lacustrine origin that overlie the Late Cretaceous Kanguk Formation and the Miocene Beaufort Formation record preglacial events of

Pliocene and (or) early Quaternary age and are assigned to the Worth Point Formation. These are covered by glacial sediments of the Duck Hawk Bluffs Formation associated with the Banks Glaciation, the oldest of the three recognized glaciations to reach the Island Associated with the glacial deposits are marine or glaciomarine sediments deposited in the glacio-isostatically depressed area as the ice both advanced and retreated. These sediments are in turn covered by interglacial sediments (Morgan Bluffs Formation), by marine deposits (Big Sea sediments associated with the Thomsen Glaciation), and by younger interglacial sediments (Cape Collinson Formation). Events associated with the early Wisconsinan M'Clure Stade of the last or Amundsen Glaciation are recorded in a coastal section east of the Duck Hawk Bluffs. There, marine deposits (pre-Amundsen Sea sediments) are covered by glacial deposits (Sachs Till) of the M'Clure Stade. D/L ratios of aspartic acid in fossil wood from the Morgan Bluffs and Cape Collinson interglacial sites, respectively, vary between 0.22 and 0.31 and 0.12 and 0.13, while Holocene wood is 0.08. A composite section is proposed for these bluffs that record some of the oldest events in the Canadian Quaternary and the various units are correlated with the previously published Quaternary framework for Banks Island.

2873 VINCENT, J.-S. - 1984
Quaternary stratigraphy of the western Canadian Arctic Archipelago; *in* Quaternary Stratigraphy of Canada - A Canadian Contribution to IGCP Project 24, ed. R.J. Fulton; Geol. Surv. Can., Paper 84-10, pp. 87-100.

The western Canadian Arctic Archipelago is a polar desert situated along the margin of North America where continental Quaternary ice sheets, spreading from dispersal centres to the southeast, reached their limit on at least three occasions. On Banks Island, the Worth Point Formation comprises mainly terrestrial preglacial sediments and records the period between the Miocene and the oldest of three recognized full glaciations. Sediments assigned to Duck Hawk Bluffs Formation, Nelson River Formation, and Prince of Wales Formation were laid down during the Banks, Thomsen, and Amundsen glaciations, respectively. Sedimentary sequences show that transgressive marine events, resulting from the buildup of ice, preceded each glacial overlap of the island, and that marine regressive events related to glacio-isostatic recovery of the crust occurred during retreat of each glacier. Paleoecological studies of organic suites of sediments of Morgan Bluffs Formation - found between sediments laid down during the Banks and Thomsen glaciations - and of Cape Collinson Formation - found between sediments laid down during the Thomsen and Amundsen glaciations - indicate that interglacial conditions existed between each of these glacial stages. Deposits on Banks, Victoria, and central Melville Island are attributed to two glacial stades of the last or Wisconsin Glaciation. During the older M'Clure Stade on Banks Island (likely Early Wisconsinan), ice covered most of Victoria Island except for parts of Prince Albert Peninsula and the Shaler Mountains and flowed into Amundsen Gulf impinging on the southwest and east coast of Banks Island and into M'Clure Strait impinging on the north coast of Banks and the southcoast of Melville Island. Following a major retreat, ice advanced again in Late Wisconsinan time (Russell Stade of Banks Island) into eastern Amundsen Gulf and Viscount Melville Sound up to the northeast coast of Banks Island and the south coast of Melville Island leaving large areas of Wollaston, Diamond Jenness, and Prince Albert peninsulas and the Shaler Mountains of Victoria Island unglaciated. In the Viscount Melville Sound area this ice surged in the form of an ice shelf about 10 ka, based on the dating of shell-bearing marine sediments underlying and overlying glacial sediments of this stade on Banks, Victoria, and Melville Islands. Although local glaciers may have existed on uplands of eastern and western Melville Island and Prince Patrick Island, there is no direct evidence for complete Wisconsinan Stage ice cover of the western Queen Elizabeth Islands. Glacial sediments are present in these areas but are likely related to an extensive pre-Wisconsinan continental glaciation possibly equivalent to the Banks Glaciation of Banks Island.

2874 VINCENT, J.-S., MORRIS, W.A., and OCCHIETTI, S. - 1984
Glacial and nonglacial sediments of Matuyama paleomagnetic age on Banks Island, Canadian Arctic Archipelago; *GEOLOGY*, vol. 12, pp. 139-142.

Preliminary paleomagnetic investigations of unconsolidated sediments from Duck Hawk Bluffs on Banks Island, in the Canadian Arctic Archipelago, have defined magnetite-residing magnetizations that exhibit systematic polarity correlations between temporally equivalent units from spatially separate stratigraphic sections. The preglacial Worth Point Formation sediments and overlying Duck Hawk Bluff Formation sediments (including marine and glacial deposits laid down during the Banks Glaciation) have magnetically reversed directions and therefore are probably of Matuyama age (<730 Ka). Deposits of the younger Morgan Bluffs and Cape Collinson interglacials and Thomsen and Amundsen glaciations are normally magnetized and therefore of Brunhes age (<730 Ka). These results provide the first minimum-age estimate for the Worth Point Formation organic deposits and for the Banks Glaciation, the oldest and strongest glaciation recorded in the western Arctic. The new time framework will facilitate correlations with terrestrial sequences of Beringia and early Pleistocene Arctic Ocean sediments.

2875 VÖLK, H.R. - 1981
Geology, tectonics and structural pre-disposition of larger landforms in the expedition area Oobloyah Bay - Neil Peninsula, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 47-59.

A short tectonical outline of the expedition area is given and the strong bearing of the geologic-tectonical frame work upon the large scale morphological pattern of the area is pointed out.

The geological frame of the expedition area is mainly built up by Younger Paleozoic and Mesozoic sedimentary rocks of the Sverdrup Basin. Associated with these rocks occur volcanic sills and dikes.

The tectonic evolution, folding and uplifting, during the Tertiary eventually resulted in regularly folded mountain ranges similar to the Swiss-French Jura Mountains. It can be shown that direction of tectonic lineaments, closely determine the direction of valleys and fiords.

Moreover it is evident, that the landforms of the tectonic anticlinorium had to become mountain ranges with rugged crests and summits typical for high mountain morphology due to their high orographic elevation, in contrast to the landforms of the tectonic synclinorium in low orographic positions which exhibit smooth anticlinal ridges and synclinal valleys.

2876 VÖLK, H.R. - 1981
Delta- and river-history in the glacioisostatic uplift region of the Oobloyah Bay during the younger Quaternary, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 285-309.

At Oobloyah Bay, NW Ellesmere Island, delta terraces composed of fluviomarine sandlayers (below) and fluvial gravels (above) were observed. They reach an elevation of 65 m above present sealevel. To the writers opinion there are 6 terrace generations, each of which can be subdivided in up to 3 minor terraces. The terraces are situated at the mouth of Heidelberg River, the main river in the area, as well as in the debouching area of Nukapingwa River and several other small riverlets. Some of the delta terraces can be traced upstream changing into fluvial terraces, viz, rock benches mostly with a thin cover of coarse sandy gravel along the adjoining canyon and sand terraces further upstream in the Heidelberg Valley.

The staircase-like geomorphological situation of the deltaic complex is interpreted in this context as interaction of regional glacioisostatic uplift and worldwide glacioeustatic rise of sealevel. This interaction, which temporarily led to constant local sealevels in relation to the land, in the course of time as a whole however produced an emergence of the coastal region.

Fossil tundra moss remnants and small relics of willow stems in the fluviomarine sandlayers of two delta terraces, DT 3 and DT 4, 22-39 m a.s.l. yielded radiocarbon dates of 12 870 BP and 4 630 BP. For the higher presumably older terraces DT 5 and DT 6 situated in 52-65 m a.s.l. a radiocarbon age of 12 870 BP and 17 430 BP can be assumed. This assumption is based on dated phytogenetic fossil material of fluviomarine sandlayers in 95 m a.s.l., which gave radiocarbon ages of 17 340 BP and 25 300 BP.

The youngest delta terrace DT 1 can be dated as approximately 2 500 BP by analogy in age with a fossil soil on a river terrace apparently connected with the first one.

Should these radiocarbon ages as communicated and interpreted here turn out to be correct it had to be concluded that the largest part of the Heidelberg Valley E of Oobloyah Valley already 25 000 BP has been free of glacier ice and must have borne a tundra vegetation.

2877 WALL, J.H. - 1983
Jurassic and Cretaceous foraminiferal biostratigraphy in the eastern Sverdrup Basin, Canadian Arctic Archipelago; *Bul. Can. Pet. Geology*, vol. 31, no. 4, pp. 246-281.

The Jurassic and Cretaceous rocks on eastern Axel Heiberg Island and Fosheim Peninsula of west-central Ellesmere Island comprise a 2200-metre-thick series of transgressive-regressive cycles of generally shallow-water shelf and fluvial-deltaic sediments in the eastern portion of the Sverdrup Basin. Eleven foraminiferal assemblages are recognized from the Savik, Awingak, Deer Bay, Isachsen, Christopher and Kanguk Formations, with an age span from Toarcian (Early Jurassic) to Campanian (Late Cretaceous). Age assignments for these assemblages are based in decreasing order of confidence on direct macrofaunal (usually ammonite) association, partial or indirect macrofaunal control with regional comparison of foraminifera, and stratigraphic position.

Dating of the lower six assemblages from the Savik, Awingak and Deer Bay Formations (Toarcian through Valanginian (Early Cretaceous) is dependent largely on integration with the macrofaunal zones. In this sequence many of the identifiable foraminiferal species are relatively long-ranging while most other forms can only be compared with known taxa or are new. The assemblage within the Isachsen Formation is estimated as Barremian-Aptian from its position between dated strata. The Albian ages of the two assemblages in the Christopher Formation are determined by a combination of the ammonite affiliation and comparison of the foraminifers with those in well-dated sequences of northern North America. The two assemblages from the Kanguk Formation are dated Turonian to Late Campanian mainly by comparison of the foraminifers with those in the Western Interior region of Canada, supplemented by indirect macrofaunal evidence.

The Toarcian and Aalenian assemblages show affinity with those from northern Alaska and Svalbard. Although the remaining Middle Jurassic is not represented in the sections studied, a similar trend is continued in the Late Jurassic, when close biogeographic affinities were established also in Western Siberia and the Canadian Arctic Mainland. The pre-Albian Early Cretaceous microfaunas are entirely boreal in aspect, whereas the Albian suites are widely distributed in the Western Interior region of North America as well as in the Arctic. The Turonian through Campanian foraminiferal faunas correspond closely with those in Alberta and Saskatchewan.

The foraminiferal faunas generally are dominated by arenaceous components of apparent neritic habitat. The entirely arenaceous, low-diversity, probably marginal and brackish marine microfauna within the Isachsen Formation is fairly widely distributed in the eastern Sverdrup Basin and is developed within the basal shales of the Christopher Formation on Mackenzie King Island in the western part of the basin. The variable magnitude of the sub-Isachsen disconformity in the eastern Sverdrup Basin is revealed by the progressive disappearance of foraminiferal assemblages of Early Volgian to Valanginian age in the Deer Bay Formation.

2878 WASHBURN, A.L. - 1983
Palsas and continuous permafrost; *in* Proc. Fourth Inter. Conf. on Permafrost, Nat. Academy Press, Washington, D.C., pp. 1372-1377.

This report describes peaty mounds in continuous permafrost, especially near Resolute, Cornwallis Island, Arctic Canada. Dome-shaped permafrost mounds here are up to about 60 cm high and 8 m in diameter. They are covered with tundra vegetation, have an active layer some 20 cm thick, and are characterized by a permafrost core of icy peat and/or silt. Some mounds also occur as similarly low but more irregular forms, others as parts of low plateaulike rises up to 1,600 m^2 in area. Most of the observed mounds are in or near present or former drainage lines that remain moist much of the summer. Field relations suggest that the ice of some mounds is primarily segregation ice, that the ice of others may include injection ice, and that some mounds are related to disintegration of plateaulike rises. It is concluded that most of the peaty Resolute mounds that are some 50 cm or more high and 2 m or more in diameter should be regarded as palsas.

2879 WASHBURN, A.L., and STUIVER, M. - 1985
Radiocarbon dates from Cornwallis Island area, Arctic Canada - an interim report; *Can. J. Earth Sci.*, vol. 22, no. 4, pp. 630-637.

New radiocarbon dates from the University of Washington's Quaternary Isotope Laboratory are given for Cornwallis Island, Northwest Territories, Canada, and these and other radiocarbon dates for the area are assembled in a diagram, including the envelope of a tentative emergence curve. Most of the new dates are derived from surface collections but appear to represent a consistent altitude - age relationship confirming the pattern of previously published dates for the general region.

The oldest of the new Holocene dates on marine shells indicate that the Resolute Bay area began emerging by at least 9700 years BP. The highest well developed marine strandlines recognized to date are at an altitude of ca. 105 m. However, the postglacial marine limit is probably some 10 m or more higher. As in adjacent regions, early postglacial emergence was initially rapid, of the order of an average 8.3 m/100 years for the first recorded 75 m, then slowed to an average 0.5 m/100 years for the last 40 m.

2880 WATTS, S.H. - 1983
Weathering pit formation in bedrock near Cory Glacier, southeastern Ellesmere Island, Northwest Territories; *in* Current Research, Part A; Geol. Surv. Can., Paper 83-1A, Scientific and Technical Notes, pp. 487-491.

2881 WATTS, S.H. - 1983
Weathering processes and products under arid arctic conditions. A study from Ellesmere Island, Canada; *Geogr. Ann.*, vol. 65A, no. 1-2, pp. 85-98.

An assemblage of highly weathered bedrock forms is reported from an upland ridge at 500 m a.s.l. near Cory Glacier on the southeastern coast of Ellesmere Island. Examples of grus accumulations, tafoni, weathering pits and tors are described. The role of salt crystallization on the microfracturing process responsible for their formation is postulated on the basis of field observations and water chemistry data. This upland ridge has apparently undergone minimal stripping through the Wisconsin and may have been protected beneath cold based ice over much of that time.

2882 WATTS, S. - 1984
Highly Weathered Bedrock Terrain - an enigma in Arctic Canada; *GEOS*, E.M.& R., vol. 13, no. 3, pp. 7-10.

Recently earth scientists have realized that glacial ice is a dynamic medium, which behaves quite differently under varying temperature and pressure conditions. In very cold temperatures - widely believed dominant during the major glacial periods, for example - ice freezes to its bed and flows internally by deforming, folding, faulting and compressing. So the bottom of the ice is *not* constantly sliding along, incorporating abrasive material to erode the underlying landscape as the glacier moves over it. Rather, by freezing to its bed, a glacier can preserve underlying features intact. The implications of this point may be profound. Although large ice sheets have covered Canada almost entirely numerous times over the past two million years, significant stripping of the landscape need not necessarily have occurred at these times. Moreover, classical glacial features such as drumlins and eskers are not necessarily suitable criteria for delineating the extent of former glaciations.

2682 WEBER, J.R. - 1985
Crustal Section Across the Central Arctic Ocean; *Abstract in Geophysics*, vol. 50, no. 8, p. 1362. Presented at CSEG/CGU Convention.

2883 WYNNE, P.J., IRVING, E., and OSADETZ, K. - 1983
Paleomagnetism of the Esayoo Formation (Permian) of northern Ellesmere Island: possible clue to the solution of the Nares Strait dilemma; In: M. Friedman and M.N. Toksöz (eds.), Continental Tectonics: Structure, Kinematics and Dynamics, *Tectonophysics*, vol. 100, pp. 241-256.

The Esayoo Formation (Lower Permian) of northern Ellesmere Island (81°N, 82°W) has been sampled at two localities (twelve sites, 88 cores studied) in the Early Tertiary (Eurekan orogeny) fold and thrust belt of the northern Sverdrup Basin, northern Ellesmere Island. The directions of remanent magnetization at the two localities are in excellent agreement after correction for geological tilt. Their mean is 126.2°, -61.8° (β (sites) = 12, k = 105 α_{95} = 4.3°) and the corresponding paleopole is 48.1°N, 159.2°E (K = 52, A_{95} = 6.1°). Comparison with Early Permian reference paleopoles for North America shows that the formation of overthrust sheets has produced no paleomagnetically detectable displacement in a paleolatitudinal sense as would be inferred from the geology, but there is a significant anticlockwise rotation of 36 ± 8°. This rotation is the first to be observed in the Canadian Arctic Islands. Geological evidence allows no more than about 50 km of lateral motion along Nares Strait between Ellesmere Island and Greenland. This falls far short of the 300 km

of relative motion required by the marine geophysical evidence for the opening of the Labrador Sea and Baffin Bay. This discrepancy between the geological and geophysical evidence is the Nares Strait paradox. Evidently relative motion between Greenland and Ellesmere Island is not restricted to Nares Strait itself and must be more generally distributed across Ellesmere Island. We suggest that the 36° rotation observed is a manifestation of this distributed strain, and therefore provides a clue to the solution of the Nares Strait paradox.

2884 YOUNG, F.G., and McNEIL, D.H. - 1984
Cenozoic stratigraphy of the Mackenzie Delta, Northwest Territories; *Geol. Surv. Can.*, Bull. 336, 63 p.

Over 10 km of Cenozoic sediments accumulated beneath the modern Mackenzie Delta within the Richards Island Basin, which is flanked to the southeast by the northern Interior Platform and to the southwest by the Northern Cordillera. Northward, this basin forms part of the continental terrace wedge of the Beaufort Sea.

Cenozoic deltaic sediments of the Richards Island Basin are divisible into two main facies; mud-dominant and sand-dominant, corresponding generally to prodeltaic and delta front to delta plain depositional environments respectively. These two facies, along with major unconformities, form the basis for defining formations within this sequence. In ascending order, the Cenozoic formations (new units in heavy print) are: Reindeer Formation, including the Aklak and sandstone-mudstone members (the latter being the major Cenozoic hydrocarbon reservoir), *Richards Formation*, *Kugmallit Formation* including *Ivak* and *Arnak* members, *Mackenzie Bay Formation*, Beaufort Formation, and *Nuktak Formation*.

The Reindeer Formation, formed by northward progradation of a delta plain to delta front facies complex during mid-Paleocene to Early Eocene times, consists of sandstone, silty mudstone and minor amounts of conglomerate and coal. Its major source area was the western tectonic highland, but the uplifted Eskimo Lakes fault zone to the southeast also contributed clastic sediments. Deltaic depocentres at this time developed in the Richards Island and northern Tuktoyaktuk Peninsula areas. The Reindeer Formation is rich in temperate terrestrial palynomorphs and yields sparse, brackish water foraminifers of the *Saccammina-Trochammina* spp. assemblage.

The Reindeer is conformably overlain by the Richards Formation, a northward thickening prodeltaic facies consisting of mudstone and shale deposited after subsidence and transgression in Early to Middle Eocene time. The formation is marked by the *Haplophragmoides* spp. agglutinated foraminiferal assemblage and, in the lower part, by a rich zone of dinoflagellates dominated by *Wetzeliella* spp. The upper part of the Richards Formation probably represents the northeastward-migrating toe of a major upper Paleogene deltaic wedge (Kugmallit Formation), which thickens markedly north and northeastward. The Kugmallit Formation consists of sand, mudstone, gravel, and lignite. It is conformable (north) to probably disconformable (south) over the Richards Formation. A rich terrestrial palynoflora, dated latest Eocene to Oligocene, occurs in the Kugmallit.

Following deposition of the Kugmallit deltaic wedge, possibly in Middle to Late Oligocene time, the immediate area of the Mackenzie Delta was uplifted; a major unconformity now separates Neogene strata from Paleogene. To the north and northwest, however, deposition seems to have been continuous and the Neogene-Paleogene contact is in a conformable marine mudstone sequence (Mackenzie Bay Formation). A basin in the Richards Island area still existed with the advent of early Neogene deposition. Gravelly fluvial and fan-delta sediments of the Beaufort Formation are intertongued with, and replaced seaward in the basin by, the marine muds of the Mackenzie bay Formation, which conformably overlies the Kugmallit. The Mackenzie Bay Formation carries cool-temperate to boreal terrestrial palynomorphs and the neritic *Cibicides* spp. foraminiferal assemblage, which is rich in calcareous benthonic species.

During the Pliocene, the sea may once again have retreated from the Mackenzie Delta area, with subsequent scouring of the upper surface of the Beaufort-Mackenzie Bay sequence causing a widespread unconformity. The Pliocene-Pleistocene Nuktak Formation records the last offlapping deltaic sequence, prior to final marine transgression over the area, and Late Pleistocene complexities caused by advancing and retreating continental ice sheets. The Nuktak consists of nonmarine (lower, gravel member) and marine (upper, mud member) facies and contains the cool water, inner shelf, *Elphidium* spp. foraminiferal assemblage, and a variety of *in situ* fossils, as well as conspicuous reworked foraminifers and palynomorphs.

GEOPHYSICS

2649 AKSU, A.E. - 1985
Paleomagnetic stratigraphy of the CESAR cores; *Geol. Surv. Can.*, Paper 84-22, pp. 101-114. *CESAR Contr. No 14.*

2652 ASUDEH, I., GREEN, A.G., and FORSYTH, D.A. - 1985
The Uniform Waveforms of Arctic Crustal Data from CESAR 1983: An Extensive Study of Multiple Reflections and P-to-S Converted Phases; *Abstract in Geophysics*, vol. 50, no. 8, p. 1362-1363. Presented at CSEG/CGU Convention.

2885 ASUDEH, I., FORSYTH, D.A., JACKSON, H.R., STEPHENSON, R., and WHITE, D. - 1985
1985 Ice Island Refraction Survey, Phase I Report, *Energy, Mines & Res.*, Earth Phys. Open File No. 85-23, Geol. Surv. Can. Open File No. 1196, 138 p. *Ice Island Contr. No. 2.*

The April 1985 Ice Island seismic refraction survey included five reversed profiles parallel and perpendicular to the polar margin northeast of Ellesmere and Axel Heiberg Islands. A total of 31 shots fired into a total of 61 recording stations yielded 300 km of refraction line with an effective receiver spacing of 2.5 km.

2716 BALKWILL, H.R., and FOX, F.G. - 1982
Incipient rift zone, western Sverdrup Basin, Arctic Canada; *in* Third Inter. Sym. on Arctic Geology, eds. A.F. Embry and H.R. Balkwill, Can. Soc. Petroleum Geologists Memoir 8, December 1982, pp. 171-187.

2886 BURGESS, M.M., JUDGE, A.S., TAYLOR, A.E., and ALLEN, V.S. - 1985
Thermal Observations of Permafrost Growth at the Illisarvik Drained Lake Site, Richards Island, Mackenzie Delta, N.W.T.; *in* Proc. 14th Arctic Workshop, Arctic Land-Sea Interaction, November 6-8, 1985, Dartmouth, N.S., pp. 188-190.

In August 1978, "Illisarvik Lake", located on a peninsula of northern Richards Island in the Mackenzie Delta, N.W.T. and on the verge of self-drainage by natural shoreline erosion, was artificially drained. The Illisarvik experiment, proposed by Dr. J.R. Mackay, is a unique long term investigation of permafrost growth under full scale natural conditions. The predrainage lake measured some 300 x 600 m, was 45 m from the sea coast at its closest point, with a mean lake surface 7 m above sea level and maximum water depths of 4.5 m. The freezeback of the thaw-bulb (talik) beneath the lake bed and associated permafrost processes (redistribution of moisture, ice segregation and frost heave, active layer growth, ice-wedge cracking) have been the subject of ongoing multidisciplinary research, undertaken in large part by Dr. Mackay. The Earth Physics Branch (EPB) of Energy, Mines & Resources has been a principal participant through its investigations of the ground thermal regime.

2729 CHRISTIE, K.W., and FAHRIG, W.F. - 1983
Paleomagnetism of the Borden dykes of Baffin Island and its bearing on the Grenville Loop; *Can. J. Earth Sci.*, vol. 20, pp. 275-289.

2887 DAWSON, E., and NEWITT, L.R. - 1984
Magnetic Declination in Canada from 1750 to 1980; *The Canadian Surveyor*, vol. 38, no. 1, pp. 35-40. EPB Contr. No. 1086.

Tables of magnetic declination for the period 1750-1980 have been compiled for 122 locations in Canada. These are intended primarily to assist surveyors who require such information when retracing old survey lines. Estimated errors vary from ± 1.5° prior to 1850 to ± 0.5° for the present century.

Simplified declination charts for the years 1800, 1850, 1900 and 1980, and secular variation graphs at selected sites illustrate the complexity of the secular variation in Canada during historic times.

2655 FORSYTH, D.A., and WEBER, J.R. - 1985
Crustal structure of the central Arctic Ocean Basin: Seismic and gravity interpretation of the Lomonosov and Alpha ridges; *Abstract in* Inter. Workshop on Density Distribution of the Lithosphere, Inst. Geodesy & Photogrammetry, ETH, Zurich, Rep. No. 102, p. 19.

2656 FORSYTH, D.A., and JACKSON, R. - 1984
Alpha and Lomonosov Ridge crustal structures; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 86.

2888 FORSYTH, D., ASUDEH, I., JACKSON, R., STEPHENSON, R., and WHITE, D. - 1985
Ice Island Refraction Experiment Field Report, April 30, 1985; *Energy, Mines & Res.*, internal report, 11 p. *Ice Island Contr. No. 1.*

The main purpose of the seismic refraction survey was to assess the thickness and areal distribution of potential sedimentary basins of the polar continental margin northwest of Ellesmere and Axel Heiberg Islands. In addition, information pertaining to deep crustal and upper mantle structure was sought.

The survey consisted of a 240 km long reversed refraction line parallel to the Arctic continental margin near the shelf break as well as two 60 km reversed lines, one perpendicular to the other, on the continental shelf. The positions of the lines are shown in Fig. 1.

The seismic recorders, known as "backpacks", were placed at approximately 5 km intervals and shots fired to supply seismic arrivals at approximately 2.5 km spacing. A total of 31 shots were fired and were recorded at 300 backpack files.

The field program was staged from the Canadian Ice Island located at 81 43.6 N, 93 24.7 W, from April 15 to May 2, 1985. The cold northern environment had associated with it a variety of unique operational constraints. The purpose of this report is to describe the logistics involved in the program so that in future years improvements on the system can be implemented.

2889 FORSYTH, D., and JACKSON, R. - 1986
1986 Ice Island Seismic Refraction Report; *Energy, Mines & Res.*, internal report, 13 p. *Ice Island Contr. No. 7.*

The purpose of the 1986 seismic refraction survey was to extend the 1985 study of the thickness and distribution of potential sedimentary basins on the continental shelf north of Ellesmere and Axel Heiberg Islands. The survey plan was based on the results of the '85 survey together with consideration of the Island's position and the available regional geology, magnetic, gravity, bathymetric data. The data will best outline the general crustal structure of the mid to upper crust and provide clues to the nature of the lower lithosphere and tectonic evolution of the polar margin.

2890 FRANSHAM, P., FRITZ, P., and MICHEL, F. - 1979
Lake Illisarvik Project - Progress Report 1979; *in* Drained Lake Experiments for Investigation of the Growth of Permafrost in the western Arctic - A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., J.A. Hunter ed., 1980.

2659 JACKSON, H.R. - 1985
Seismic reflection results from CESAR; *Geol. Surv. Can.*, Paper 84-22, pp. 19-23. *CESAR Contr. No. 10.*

2891 JESSOP, A.M., LEWIS, T.J., JUDGE, A.S., TAYLOR, A.E., and DRURY, M.J. - 1984
Terrestrial Heat Flow in Canada; *Tectonophysics*, vol. 103, pp. 239-261.

Heat flow has been measured at 214 separate sites in Canada and on the surrounding continental shelves. Most geological provinces show average heat flow that conforms approximately to world averages for areas of similar tectonic age, but the northern Prairies show an anomalously high heat flow that is probably controlled by deep water movement, and the coastal zone of southern British Columbia shows a low heat flow that is believed to be associated with recent subduction of small ocean plates.

2892 JOHNSON, G.W. - 1984
Astronavigation for the Lomonosov Ridge Experiment; *Surveying and Mapping*, vol. 44, no. 3, pp. 237-245. *LOREX Contr. No. 16.*

The Lomonosov Ridge is an aseismic submarine mountain range that bisects the Arctic Ocean in the immediate vicinity of the North Pole. In the spring of 1979 the Canadian Department of Energy, Mines & Resources (EMR) undertook a large-scale multidisciplinary project to study its nature and origin. One research objective of the project was to use deflections of the vertical derived from astronomically determined latitudes and longitudes to help define a model of the density structure of the Ridge. During a 30-day period approximately 1,200 daylight star observations were made and 87 astronomic position fixes established as the *three* project camps drifted across the Ridge *between latitudes* 88°20' *and* 89°07' *North.*

2662 JUDGE, A., ALLEN, V., and TAYLOR, A. - 1984
Geothermal measurements on the Alpha Ridge during CESAR; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, pp. 84-85.

2558 MacDOUGALL, J.R. - 1984
Final Field Report, P.C.S.P. survey, Prince Regent Inlet, Proj. File no. 5452-7312; *Fisheries & Oceans*, Can. Hydrographic Serv., Central Region, internal report, 99 p.

2786 MACKAY, J.R. - 1973
Research Proposal - Drained lake experiments for investigation of the growth of permafrost in the western Arctic; *in* Drained lake experiments for investigation of the growth of permafrost in the western Arctic - A progress report prepared for the Permafrost Subcomittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Canada, ed. J.A. Hunter, 1980.

2893 MACKAY, J.R. - 1978
Progress report - December 1978; *in* Drained lake experiments for investigation of the growth of permafrost in the western Arctic - A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., ed. J.A. Hunter, 1980.

2789 MACKAY, J.R. - 1979
Progress report on Illisarvik - Summer 1979; *in* Drained lake experiments for investigation of the growth of permafrost in the western Arctic - A progress report prepared for the Permafrost Subcommittee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Can., ed. J.A. Hunter, 1980.

2797 MacLEAN, B., WOODSIDE, J.M., and GIROUARD, P. - 1984
Geological and geophysical investigations in Jones Sound, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 84-1A, pp. 359-365.

2800 MÄUSBACHER, R. - 1981
Near surface soil temperature measurements at Oobloyah Bay, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 487-505.

2806 MIALL, A.D. - 1984
Sedimentation and tectonics of a diffuse plate boundary: the Canadian Arctic Islands from 80 Ma B.P. to the Present; *Tectonophysics*, vol. 107, pp. 261-277.

2817 NARBONNE, G.M., and DIXON, O.A. - 1982
Physical correlation and depositional environments of Upper Silurian rubbly limestone facies in the Canadian Arctic Islands; *in* Arctic Geology and Geophysics, eds. A.F. Embry and H.R. Balkwill, Can. Soc. Pet. Geologists Memoir 8, pp. 135-146.

2894 NEWITT, L.R., and DAWSON, E. - 1984
Magnetic Observations at International Polar Year Stations in Canada; *Arctic*, vol. 37, no. 3, pp. 255-262.

During the First International Polar Year (1882-83) magnetic observatories were established in northern Canada at Fort Rae, Fort Conger, and Clearwater Fiord. Repeat magnetic observations made during the centenary of the First Polar Year enable a determination of the secular variation at each of these locations. During the last 100 years the declination has increased easterly by over 20° at Fort Conger and at Clearwater Fiord; however, it has decreased by only 9° at Fort Rae. The total intensity has decreased by over 1900 nT at Fort Rae, but at Clearwater Fiord and at Fort Conger the decrease has been about 1500 nT and 1000 nT respectively. This implies that the decrease in the non-dipole field evident over most of North America in recent times has not been as great in the high Arctic.

2668 NIBLETT, E.R., MICHAUD, C., and KURTZ, R.D. - 1984
Magnetotelluric measurements over the Alpha Ridge; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 86.

2895 O'CONNOR, M.J. & ASSOCIATES LTD. - 1982
A Review of the distribution and occurrence of shallow acoustic permafrost in the southern Beaufort Sea; *Geol. Surv. Can.*, Contract No. 07SC-23420-2-M562, 114 p.

In 1980 the Geological Survey of Canada initiated a major synthesis of the geological, geotechnical and geophysical data which had been collected in the Canadian Beaufort Sea during the previous decade. As part of this synthesis, government reflection and refraction information was combined to prepare a preliminary map showing the distribution of shallow acoustic permafrost (APF) on the continental shelf. The present report undertakes to increase the level of confidence of the initial shallow APF study by incorporating the extensive high resolution reflection data available from the petroleum operators, and correlating this seismic information with groundtruth data available from the many geotechnical boreholes on the shelf.

2820 O'CONNOR, M.J. & ASSOCIATES Ltd. - 1982
An evaluation of the regional surficial geology of the southern Beaufort Sea; A Report for the Geol. Surv. Can., 188 p.

2671 OVERTON, A. - 1984
Seismic reflection profiles across the Lomonosov Ridge and on the Alpha Ridge, Arctic Ocean Basin; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, pp. 85-86.

2824 PALMER, H.C., BARAGAR, W.R.A., FORTIER, M., and FOSTER, J.H. - 1983
Paleomagnetism of Late Proterozoic rocks, Victoria Island, Northwest Territories, Canada; *Can. J. Earth Sci.* vol. 20, pp. 1456-1469.

2896 PARAMESWARAN, V.R., and MACKAY, J.R. - 1983
Field measurements of electrical freezing potentials in permafrost areas; *in* Proc. Fourth Inter. Conf. on Permafrost, Nat. Academy Press, Washington, D.C., pp. 962-967. DBR Paper No. 1170, NRCC 23091.

Electrical potentials developed during freezing of natural soils have been measured in two permafrost areas: one in a saturated sand in a drained lake (Illisarvik) on Richards Island where permafrost was aggrading downward 5.65 m below ground; the other, in a mud hummock in the active layer at Inuvik. Peak potentials of up to 1350 mV were measured on electrodes located on the advancing freezing front at Illisarvik. At Inuvik, maximum freezing potentials of up to 700 mV were measured as the active layer froze in winter. There was also evidence of downward water migration and freezing as the ground started to thaw at the surface in spring.

2897 PARAMESWARAN, V.R., JOHNSTON, G.H., and MACKAY, J.R. - 1985
Electrical potentials developed during thawing of frozen ground; *in* Proc. Fourth Inter. Sym. on Ground Freezing, August 5-7, 1985, Sapporo, Japan, eds. S. Kinosita and M. Fukuda; A.A. Balkema, Boston, pp. 9-15.

2838 ROBERTSON, P.B., COLEMAN, L.C., OLSEN, E.J., and KISSIN, S.A. - 1982
Canadian Arctic meteorite search: 1981; *Meteoritics*, vol. 17, no. 3, pp. 163-170.

2839 ROBERTSON, P.B., and SWEENEY, J.F. - 1983
Haughton impact structure: structural and morphological aspects; *Can. J. Earth Sci.*, vol. 20, no. 7, pp. 1134-1151.

2898 SERSON, P.H. - 1982
The Search for the North Magnetic Pole; *Transactions Royal Soc. of Canada*, Series IV, Vol. XX, pp. 391-398. Earth Phys. Br. Contr. No. 946.

The earliest known reference to a magnetic pole on the surface of the earth is in a letter written in 1546 by the Flemish geographer Gerardus Mercator, inventor of the Mercator map projection. He dismissed the popular idea that the mariner's compass was directed by the star Polaris, and calculated the position of the north magnetic pole as northwest of Bering Strait at latitude 79°N. He assumed that at any location the compass points directly at the magnetic pole, and thus the pole's position could be computed as the intersection of great circles drawn through two or more suitable points in the local compass direction. Although at that time the magnetic declination - the angle between true north and magnetic north - had been measured at many locations in Europe, Mercator apparently did not have access to the original observations and had to deduce his values of declination, in a most resourceful way, from latitude errors in published nautical charts. Practical sailing charts were commonly drawn with reference to magnetic north, ignoring changes in declination. In compiling his map of Europe, Mercator had to correct the resulting distortion in order to fit the sailing charts to the astronomically determined latitudes of various cities. In the process, he recovered the magnetic information.

2848 SOBCZAK, L.W. - 1982
Fragmentation of the Canadian Arctic Archipelago, Greenland, and surrounding oceans; *in* Nares Strait and the drift of Greenland: a conflict in plate tectonics, eds. P.R. Dawes & J.W. Kerr, Meddr. Grønland, Geosci. no. 8, pp. 221-236.

2899 SOBCZAK, L.W., and OVERTON, A. - 1984
Shallow and deep crustal structure of the western Sverdrup Basin, arctic Canada; *Can. J. Earth Sci.*, vol. 21, no. 6, pp. 902-919.

An analysis of gravity data along two detailed profiles over the western Sverdrup Basin in the Canadian Arctic supports a seismic refraction model. Drill holes as deep as 5.4 km near the profiles provide excellent density control. Mean densities in the thickest part of the basin exceed those in the thinner parts by an average of 0.13 Mg/m^3.

Bouguer anomalies corrected for the effect of water, sedimentary, and crystalline layers indicate significant anomalies that vary in width from 20 to 275 km and in amplitude from 3 to 46 mGal (30 to 460 $\mu m\ s^{-2}$). These can all be explained by density structures within the

sedimentary column. Sedimentary thickness along the profiles varies from 9 to 17.4 km, crystalline thickness varies from 18 to 33 km, and the total crustal thickness varies from 34 to 42 km. The analysis also shows: (1) negative gravity effects of about 60 to 120 mGal (600 to 1200 $\mu m\ s^{-2}$) due to the mass deficiency of the water and sediments are offset by positive gravity effects of similar magnitude due to crustal thinning; (2) isostatic compensation of water and sediments by a mantle antiroot is evident from a regional free-air anomaly near zero and the apparent inverse variation of sedimentary thickness with the thickness of the crystalline crust; (3) in the thickest part of the basin, undulations at the sedimentary - crystalline boundary are in phase with and smaller in amplitude than undulations at the crust-mantle boundary; conversely, in the thinnest part of the basin, these undulations are out of phase and larger in amplitude.

These effects may be explained by stretching of a crystalline crust and a general decrease in crustal rigidity with depth during sediment accumulation and subsequent orogenic events.

2900 SOBCZAK, L.W., and SCHMIDT, M. - 1985
Preliminary Report, Gravity Survey along the Seismic Refraction Line from Ice Island, N.W.T.; *Earth Phys. Br.*, E.M.& R., Internal Report No. 85-15, 5 p. *Can. Ice Island Contr. No. 3.*

Two gravity meters (G75 and G498) were used to make control ties from Resolute Bay to the Ice Island; one (G 75) was set up on the Ice Island at the navigation hut in an insulated box and acted as base monitor and the other (G498) was used as a mobile unit for the period April 19-24. Then G75 was used as a mobile unit from April 29 and 30. Altogether seventy-seven gravity observations and 61 water depths were taken along the seismic refraction lines.

2674 SWEENEY, J.F. - 1984
Arctic Tectonics - What We Know Today; *GEOS*, E.M.& R., vol. 13, no. 4, pp. 8-10. *CESAR Contr. No. 3.*

2854 SWEENEY, J.F. - 1985
Comments about the age of the Canada Basin; In: Husebye, G.L. Johnson and Y. Kristoffersen (eds.) Geophysics of the Polar Regions, *Tectonophysics*, vol. 114, pp. 1-10.

2901 TAYLOR, A., JUDGE, A., and BURGESS, M. - 1983
Abandonment of Arctic wells preserved for subsurface temperature observations: a status report; *Energy, Mines & Res. Canada*, Earth Phys. Br., internal report 83-1, 40 p.

As part of a continuing northern program of the Geothermal Service of the Earth Physics Branch, subsurface temperatures have been measured at over 128 sites in the permafrost region of Canada. Data are usually gathered at resource exploration holes in cooperation with the companies involved and the Department of Indian and Northern Affairs. At the majority of these sites, EMR has no responsibility to effect a final abandonment at the completion of the science program; however, by agreement with the regulatory bodies, the Geothermal Service is responsible for certain completion procedures at a number of these sites. Since the mid-1960's, EMR has assumed responsibility to carry out final abandonment procedures at 31 wells; 23 of these are now abandoned and most of those remaining require only a simple bullplug to be placed.

This report lists the wells for which EMR is responsible and describes in detail the six sites abandoned by Branch personnel in the 1982 field season, bringing up to date a similar report prepared in 1981.

2902 TAYLOR, A., JUDGE, A., and DESROCHERS, A. - 1983
Shoreline regressions: Its effect on permafrost and the geothermal regime, Canadian Arctic archipelago; *in* Proc. Fourth Inter. Conf. on Permafrost, Nat. Academy Press, Washington, D.C., pp. 1239-1244. Earth Phys. Br. No. 1062

In the Queen Elizabeth Islands of the Canadian Arctic Archipelago, the late Quaternary event with the most profound influence on ground temperatures is shoreline regression accompanying post-glacial isostatic uplift. The coastal margins of many islands have experienced hundreds to several thousand years of submergence since 8,000 years ago. The effect on the geothermal regime is far from subtle because of the large contrast between arctic air temperatures and sea temperatures.

Permafrost thicknesses measured today reflect this surface temperature history. Two deep wells 1 km apart on Cameron Island have measured permafrost thicknesses of 726 and 660 m; the geothermal analysis attributes the difference entirely to the first, and higher, site having emerged from the sea around 7,000 years B.P., about 2,000 years before the second. Inland sites on the Sabine Peninsula of Melville Island may have, in a similar lithology, permafrost twice as thick as at coastal sites. The geothermal analysis explains this variation in terms of a simple sea regression model derived from emergence curves published for the region.

2903 TAYLOR, A., and JUDGE, A. - 1985
Abandonment of Arctic wells preserved for subsurface temperature observations: a status report; *Energy, Mines & Res. Canada*, Earth Phys. Br., Geothermal Serv. Can., internal report 85-2, 34 p.

As part of the continuing northern program of the Geothermal Service of the Earth Physics Branch, EMR, subsurface temperatures have been measured at over 128 sites in the permafrost region of Canada. Data are usually gathered at resource exploration holes in cooperation with the companies involved and in the case of petroleum exploration holes, in cooperation with the Canada Oil and Gas Lands Administration. This body regulates the manner in which wells have been made accessible for our use and sets the requirements for the final surface abandonment of the well to be undertaken at the end of the science program. At the majority of the petroleum exploration wells, the original operators have retained the responsibility to effect a final abandonment procedure at each well. At 30 wells, EMR has assumed responsibility to carry out final abandonment to the extent of placement of the final surface plug in the well casing; 25 of these are now abandoned and most of those remaining require only a simple procedure to be undertaken.

This report describes in detail the two abandonments effected by EMR during the 1984 field season, the Panarctic Garnier O-21 and Louise O-25 wells. The status of EMR's abandonment program is summarized, bringing up-to-date a similar report prepared in 1983. Over the next two years, the operators will be abandoning many of their other suspended wells, some of which EMR has been using as temperature observation sites. EMR's science program is largely complete at these wells; however, several wells are of particular interest and EMR has proposed that about 8 be instrumented for long term temperature measurements in a fashion that would allow the wells to be considered as abandoned.

2904 TAYLOR, A., and ALLEN, V. - 1985
Shallow sediment temperatures and thermal properties, Canadian Beaufort Continental Shelf; *in* Proc. 14th Arctic Workshop, Arctic Land-Sea Interaction, November 6-8, 1985, Dartmouth, N.S., pp. 207-209.

Geothermal research in the deep oceans involves the measurement of temperature gradients in the upper several metres of sediment and the determination of thermal conductivity values over the same interval. The product of these two parameters is the measured terrestrial heat flux. Transient effects such as rapid sedimentation or erosion, or variation in bottom water temperatures are recognized in the raw data and corrections may usually be made, yielding a heat flux typical of the geologic environment.

2868 VEILLETTE, J., and NIXON, M. - 1980
The development and use of lightweight equipment; *Northern Development*, Jan./Feb., pp. 21-23.

2682 WEBER, J.R. - 1985
Crustal Section Across the Central Arctic Ocean; *Abstract in Geophysics*, vol. 50, no. 8, p. 1362. Presented at CSEG/CGU Convention.

2883 WYNNE, P.J., IRVING, E., and OSADETZ, K. - 1983
Paleomagnetism of the Esayoo Formation (Permian) of northern Ellesmere Island: possible clue to the solution of the Nares Strait dilemma; In: M. Friedman and M.N. Toksöz (eds.), Continental Tectonics: Structure, Kinematics and Dynamics, *Tectonophysics*, vol. 100, pp. 241-256.

GLACIOLOGY

2684 ADAMS, P. - 1985
Research station on Axel Heiberg Island, Northwest Territories, Canada; *Polar Record*, vol. 139, pp. 431-433.

2685 ALT, B.T. - 1984
Preliminary Climate Reconstructions from ice core data for the period 1800-1860 in the Queen Elizabeth Islands; Extended abstract submitted to Annual Meeting of Can. Com. on Climate Fluctuations and Man, 6 p.

2686 ALT, B.T. - 1985
1550-1620: a Period of Summer Accumulation in the Queen Elizabeth Islands; *in* Climate Change in Canada 5, Syllogeus, no. 55, ed. C.R. Harington, Nat. Museums Can., pp. 461-479.

2719 BARSCH, D., and KING, L. - 1981
Aims and program of the Heidelberg Ellesmere Island Expedition 1978; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 1-14.

2905 BARSCH, D., KING, L., and MÄUSBACHER, R. - 1981
Glaciological observations at the front of Webber Glacier, Borup Fiord area, northern Ellesmere Island, N.W.T. Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 269-284.

Webber Glacier with its impressing, six kilometer long icefront consisting mainly as a 15 to 40 m high icecliff, is the only glacier of the expedition area that is actually advancing, but there are no moraines pusned up. The glacier tongue lies today on a watershed: the meltwaters from its eastern margin flow towards Esayoo Bay; Heidelberg River originates from its western margin and drains towards Oobloyah Bay. Several observations along the 6 km long icecliff are presented and interpreted: 1) The formation of an overhanging icecliff is due to the internal differential movement in the glacier ice rather than to the reflected radiation from the tundra surfaces; 2) In the basal parts of the icecliff, folds and thrusts could be observed together with great amounts of glaciofluvial debris. This material has been incorporated into the glacier together with old aufeis including tundra material and with fresh winter snow by overriding, shearing, folding and freezing to the glacier bed. Above this zone of strongly deformed basal ice, morainic layers are exposed along shear planes. The ice layers laying above show foliation but very little morainic material; 3) Several observations along the course of Heidelberg River show, that vast tundra covered surfaces are underlain by aufeis. This aufeis has been preserved by a cover of sand and silt approximately 30 cm thick. Organic material taken within the aufeis directly ahead of the glacier front shows a radiocarbon age of 3 500 years B.P.; 4) In the lower parts of the icecliff two radiocarbon analysis of Salix wood gave ages of 37 550 ± 1 420 and 35 600 ± 1 100 years BP. This implies that 36 000 years ago Webber Glacier has been smaller than today, and the glacial sculpering of the area afterwards has been relatively small, as the radiocarbon material would probably have been eroded otherwise. The deep fiords and other glacial forms have probably been formed much earlier.

2725 BÉLANGER, J.R., and KLASSEN, R.A. - 1983-1984
Les glaciers de l'île Bylot: une fenêtre sur le passé; *GEOS*, vol. 12, no. 4, pp. 10-13.

2906 BLATTER, H. - 1985
On the Thermal Regime of Arctic Glaciers: A Study of the White Glacier, Axel Heiberg Island, and the Laika Glacier, Coburg Island, Canadian Arctic Archipelago; *Geographisches Institut der Eidg. Technischen Hochschule*, Zürich, Heft 22, 110 p.

The present work is the result of a glaciological investigation on the White Glacier, Axel Heiberg Island and on the Laika Glacier, Coburg Island, N.W.T., Canada. The work was carried out by Heinz Blatter as the dissertation theme during the years 1974/75 and 1981 to 84.

The research revealed a most detailed information on the thermal structure of glaciers. A unique contribution of the present publication, however, is the discovery of an extended temperature minimum in the core of the uppermost part of the glacier which the author attributes to the lower air temperature before the end of the last century. The present volume of the ZGS also forms the volume Glaciology No. 6 of the Axel Heiberg Island Research Reports.

2630 BOURGEOIS, J.C., KOERNER, R.M., and ALT, B.T. - 1985
Airborne pollen: a unique air mass tracer, its influx to the Canadian High Arctic; *Annals Glaciology*, vol. 7, pp. 109-116.

2688 BRADLEY, R.S., and SERREZE, M.C. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap, Part I: mass balance; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 107-127.

2689 BRADLEY, R.S., and SERREZE, M.C. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap, Part II: topoclimate; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr, No. 49, pp. 128-166.

2690 BRADLEY, R.S., and EISCHEID, J.K. - 1985
Aspects of the precipitation climatology of the Canadian Arctic; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 250-271.

2735 DYKE, A.S., DREDGE, L.A., and VINCENT, J-S. - 1983-1984
Canada's last great ice sheet; *GEOS*, E.M.& R., vol. 12, no. 4, pp. 6-9.

2907 GILBERT, R., SYVITSKI, J.P.M., and TAYLOR, R.B. - 1985
Reconnaissance study of proglacial Stewart Lakes, Baffin Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 85-1A, pp. 505-510.

Stewart Lakes are dammed by neoglacial moraines in a through-valley between Gibbs and Sam Ford fiords in northeastern Baffin Island. Maximum water depth on the basis of spot soundings is 108 m. Glaciers are retreating at rates between 19 and 34 m/a, and the lake level has lowered from 69 m above sea level to 55 m as a result of ice retreat and downcutting of the moraines. On 13 September 1983, suspended sediment concentrations in Stewart Lakes varied from 66 to 109 mg/L. In Refuge Harbour (Gibbs Fiord) the concentration in overflowing fresh water was 135 mg/L. These values are significantly higher than those measured in most other ice-proximal lakes and fiords.

2908 HOLDSWORTH, G. - 1984
Glaciological reconnaissance of an ice core drilling site, Penny Ice Cap, Baffin Island; *J. Glaciology*, vol. 30, no. 104, pp. 3-15.

A site situated close to the main divide of the Penny Ice Cap, Baffin Island was occupied in 1979 for the purpose of determining the suitability of this ice cap for providing proxy climatic data and other environmental time series for a span of 10^4 a. A 20 m core was extracted and analysed for stable oxygen isotopes, tritium concentration, pH, electrolytic conductivity, major ion concentrations, and particulate concentration. An adjacent dedicated shallow core was analysed for pollen content to determine if a significant seasonal variation in the pollen rain existed. From these measurements, and from the observations made on the stratigraphic character of the core, the mean net accumulation rate over the approximately 30 year period covered by the core is found to be about 0.43 m water equivalent per year. This is in agreement with a single value determined 26 years earlier at a nearby site (Ward and Baird, 1954). The mean annual temperature in the bore hole was found to be close to - 14.4°C, possibly some 2-5 deg warmer than the expected mean annual surface air temperature at the site. This difference is due to the expulsion of latent heat upon freezing of melt water at depth in the snow-pack which gives rise to the many ice layers observed in the core. The percentage thickness of ice layers per year may be correlated with summer temperatures.

Total ice depths were measured using a 620 MH_z radar echo-sounder. In the vicinity of the divide, over an area of 1 km^2, the ice depths vary from about 460 to 515 m. These values compare favourably with values determined from an airborne radar depth-sounding flight carried out over the ice cap by a joint U.S. - Danish mission operating out of Søndre Strømfjord, Greenland. The data suggest that the ice-cap divide would be a worthwhile location to deep core drill with an expected useful coverage of at least the Holocene period.

2909 JEFFRIES, M.O. - 1984
Milne Glacier, northern Ellesmere Island, N.W.T., Canada: a surging glacier?; *J. Glaciology*, vol. 30, no. 105, pp. 251-253.

During the period 1966 to 1983 Milne Glacier advanced 4.25 km at a mean annual rate of 250 m a^{-1}. Since surges commonly occur over a two or three year period the maximum rate of advance could have been greater than 2 km a^{-1}. The glacier terminus has a number of features

indicative of past surge behaviour. Of these, at least three looped moraines suggest surges of the main valley glacier and tributary glaciers. As Milne Glacier is a cold glacier, surges may possibly be thermally regulated. Accumulation rates on the ice caps of northern Ellesmere Island are low hence a critical condition in the "reservoir area" will be only slowly attained. As a consequence the periodicity of surges in Milne Glacier and other High Arctic glaciers is expected to be high.

2910 KING, L. - 1981
Glaciers of Borup Fiord area, northern Ellesmere Island, N.W.T., Canada; *in* Results of Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 203-232.

The Borup Fiord area shows 195 glaciers in total. About 20 of these glaciers situated in the central part belong to the area visited by the Heidelberg Ellesmere Island Expedition in 1978. Data concerning their morphology and actual behaviour have been collected and analysed.

2911 KOERNER, R.M. - 1983
Conditions at the ice/rock interface of large ice sheets; *in* Workshop on Transitional Processes, Ottawa, November 4-5, 1982, compiled by W. Heinrich, Atomic Energy of Canada Ltd., Whiteshell Nuclear Res. Est., Pinewa, Manitoba, pp. 200-211.

The concept of the disposal of nuclear fuel waste in stable areas of the Canadian Shield is being assessed. Because of the long half-life of some of the fission products, an undisturbed life expectancy of a deep disposal vault (1000 m) of about 1×10^6 a (1 Ma) is desirable. As the Canadian Shield has been ice-covered (by the Laurentide Ice Sheet) for about 90% of the past 1 Ma, a knowledge of conditions at the ice/rock interface is of the utmost importance. This is especially true in view of a previous study that considers the location of a nuclear waste vault in an area likely to be glaciated in the future as undesirable.

The main problems concerning vault integrity under a thick ice sheet are (a) erosion of the vault "roof" by the ice sheet, (b) increased availability of water and increased water pressure under the ice sheet, and (c) increased stresses on the rock produced by the overlying weight of the ice sheet, such that fracturing can occur. This paper presents a general introduction to the thermal regime and dynamics of ice sheets in terms relevant to nuclear waste disposal. A single-domed ice sheet with its centre over Hudson Bay will be considered. The existence of other domes does not radically alter the basic arguments presented here, although their incorporation into a final model may prove necessary.

2912 KOERNER, R.M. - 1985
Canadian Arctic Islands: glacier mass balance and global sea level; *in* Glaciers, ice sheets, and sea level: effect of a CO_2-induced climatic change. Report of a Workshop held in Seattle, Washington, Sept. 13-15, 1984. United States Dept. of Energy, pp. 145-154.

The Canadian Arctic Island glaciers cover 108,600 km^2, which is 0.7 percent of the world's and 5 percent of the northern hemisphere's ice cover. It is the largest concentration of ice outside of Antarctica and Greenland. The glaciers can be divided into three basic types.

A. Dynamic ice caps and their outlet glaciers compose the greater part of the ice cover. The largest ice caps are about 20,000 km^2 in area with thicknesses commonly ranging between 300 and 800 m. Velocities vary seasonally on the outlet glaciers owing to the presence of meltwater at the bed but mean annual values of 30 m/yr are common.

B. The smaller ice caps (less than 90 km^2) are stagnant and are mostly located on plateaus 500-800 m above sea level. From their geometry they appear to vary in thickness between 20 and 60 m. The best studied of these, Meighen Ice Cap, showed a thickness of 121 m in a borehole at its highest point. However, this ice cap is unusual in many respects, for example, it lies at an elevation of only 130-250 m above sea level; it will be discussed later.

C. Ice Shelves are located along the north coast of Ellesmere Island, bordering the Arctic Ocean. The Ward Hunt Ice Shelf is the most extensive and measures 50 km x 10 km with a thickness of 40 m.

Routine mass-balance measurements have been made on at least one of each of the above types of ice mass in the past two decades. They will be discussed later.

2694 KOERNER, R.M., and FISHER, D.A. - 1985
The Devon Island ice core and the glacial record; *in* Quaternary Studies on Baffin Island, Baffin Bay and west Greenland, ed. J.T. Andrews, pp. 309-327. Allen and Unwin, Boston, 774 p.

2913 LORRAIN, R.D., and DEMEUR, P. - 1985
Isotopic evidence for relic pleistocene glacier ice on Victoria Island, Canadian Arctic Archipelago; *Arctic & Alpine Res.*, vol. 17, no. 1, pp. 89-98.

Ground ice masses are exposed in some areas of Prince Albert Peninsula, Victoria Island. Two of them were studied along the scarps of slumps during the summer of 1982. The ice was beneath a 1-m-thick Wisconsinan till and showed a clear subvertical banding. Sampling was done mainly for ice isotopic analyses but also for particle analyses. The isotopic study indicates that the sampled ground ice was formed during the Wisconsinan period because the $\delta^{18}O$ values are about 11 $^{o}/_{oo}$ lower than those of present-day surface waters. The δD-$\delta^{18}O$ relationships indicate that the ice is buried glacier ice rather than segregation ice. These ground ice masses are most probably the first example cited in the literature of Wisconsinan glacier ice in the present-day unglaciated part of the Canadian Arctic.

2641 McANDREWS, J.H. - 1984
Pollen Analysis of the 1973 Ice Core from Devon Island Glacier, Canada; *Quaternary Res.*, vol. 22, pp. 68-76.

2699 PALECKI, M.A., SERREZE, M.C., and BRADLEY, R.S. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap: Part V: boundary layer conditions; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 217-249.

2835 RETELLE, M.J. - 1985
Glacial geology and quaternary marine stratigraphy of the Robeson Channel area, northeastern Ellesmere Island N.W.T., Canada; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 9-55.

2836 RETELLE, M.J. - 1985
Late Quaternary stratigraphy and paleoenvironments of the Beaufort Lakes Basin, northeastern Ellesmere Island; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 57-106.

2700 SERREZE, M.C., and BRADLEY, R.S. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap Part III: radiation climatology; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 167-194.

2701 SERREZE, M.C., and BRADLEY, R.S. - 1985
Glacio-climatic studies of a High Arctic plateau ice cap: Part IV: energy budget; *in* Glacial geologic and glacio-climatic studies in the Canadian High Arctic, ed. R.S. Bradley, Final Rep. Nat. Science Foundation, Univ. Massachusetts Contr. No. 49, pp. 195-216.

HISTORY

2706 BRUEMMER, F. - 1984-1985
Arctic inferno - Witches' brew spews acid rain across the tundra; *Canadian Geographic*, vol. 104, no. 6, pp. 70-75.

2914 CRONIN, F. - 1982
The Polar Continental Shelf Project: Foster Parent to Arctic Travellers; *North/Nord*, vol. XXIX, no. 1, pp. 32-37.

Polar Shelf, as it is familiarly known, has gradually accepted responsibility for Arctic logistics. This means hiring fixed-wing planes and helicopters for each working season (roughly from March to October) and allocating expensive flying hours to government organizations and universities interested in investigating various aspects of the North, whether it be currents, ice, birds, whales or the skeletons of long-dead explorers. The organization, with just a handful of employees, has taken on the role of foster parent to travellers on scientific missions to the Arctic.

2915 HOBSON, G.D. - 1983
Helen Kalvak: 1901-1984; *the musk-ox*, no. 33, In Memoriam, p. 94.

2916 MAYHEW, C. - 1984
The Polar Continental Shelf Project; *GEOS*, E.M.& R., vol. 13, no. 4, pp. 1-7.

The Polar Continental Shelf Project (PCSP) was set up as a small, semi-independent unit that would collaborate with the main field survey branches of Mines and Technical Surveys. The area ultimately to be investigated runs from Alaska to Greenland, some 2600 km west to east, and extends northward from the mainland bordering the Archipelago to include the Arctic Ocean floor well beyond Ellesmere Island.

2553 McGHEE, R. - 1984
Contact between native North Americans and the medieval Norse: a review of the evidence; *American Antiquity*, vol. 49, no. 1, pp. 4-26.

2917 PHILLIPS, C. - 1985
Preserved Provisions - Food for the Royal Navy in the High Arctic, 1818-1875; *Canadian Collector*, vol. 20, no. 5, pp. 37-40.

Following the end of the Napoleonic Wars, the British Admiralty found employment for its idle fleet by resuming the search for the Northwest Passage. The development of the canning industry probably contributed to the success of 19th century Arctic exploration, for ships were able to take enough food to overwinter and to a lesser extent combat scurvy. Canned food was also very portable, enabling sledge expeditions to explore hundreds of miles without having to stop to hunt.

2918 PRINCE OF WALES NORTHERN HERITAGE CENTRE - 1985
Collected Papers on the Human History of the Northwest Territories; *Prince of Wales Northern Heritage Centre* Occasional Paper No. 1, eds. M.J. Patterson, C.D. Arnold, R.R. Janes, 167 p.

The Prince of Wales Northern Heritage Centre celebrates its sixth anniversary this year with the publication of the first volume in its new *Occasional Papers Series*. Although much has happened in the cultural sphere since the Northwest Territories Legislative Assembly embarked upon a museum program in 1972, many northern residents and people from the South who have lived and worked here feel the need as individuals to tell the story of this land. We hope that this *Occasional Papers Series* will provide these people with an opportunity to share their knowledge and insight.

2556 de HEERING, P., SUTCLIFFE, P., and DesPAROIS, M. - 1984
Underwater measurements of impact noises on ice; Presented at Can. Acoustical Assoc. Sym. of Can. Astronautics Ltd., October 22-26, 1984, Quebec City, P.Q. 6 p.

2557 de HEERING, P., SUTCLIFFE, P., and DesPAROIS, M. - 1985
Non-contact through-the-ice sounding of Arctic waters; *in* Proc. Dixième Colloque sur le traitement du signal et ses applications, May 20-24, 1985, Nice, France.

2558 MacDOUGALL, J.R. - 1984
Final Field Report, P.C.S.P. survey, Prince Regent Inlet, Proj. File no. 5452-7312; *Fisheries and Oceans*, Can. Hydrographic Serv., Central Region, internal report, 99 p.

2919 MORTIMER, A.R. - 1984
Surveys in the Queen Charlotte Islands and the Beaufort Sea: M.V. Polar Circle; Final Field Report 1983; *Fisheries and Oceans*, Can. Hydrographic Serv., Pacific Region, internal report, 37 p.

The survey of the Beaufort Sea shipping corridor has been completed after three seasons of work. The minimum depth found at the eastern end of the corridor this year was 25.9 m. The stern tow swath sounding system shows promise of working well once the problems with the tow wires are resolved. The surveys off Baillie Islands and of Parry Passage, Q.C.I., should be available to chart production before the end of the year. Regrettably, ice conditions permitted only a minimal amount of sounding on the Yukon Coast survey.

2855 SYVITSKI, J.P.M., and BLAKENEY, C.P. - 1983
Sedimentology of Arctic Fjords Experiment: HU 82-031 Data Report, Volume 1; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci., No. 12, 935 p.

2856 SYVITSKI, J.P.M. - 1984
Sedimentology of Arctic Fjords Experiment; HU 83-028 and HU 82-031 data report, Volume 2; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci., No. 28, 1130 p.

HYDROLOGY

2920 ANDERSON, J.C. - 1979
Meteorological Data Collection Program - Illisarvik 1979; *in* Drained Lake experiments for investigation of the growth of permafrost in the western Arctic. A progress report prepared for Permafrost Committee, Assoc. Comm. on Geotechn. Res., Nat. Res. Council of Canada, ed. J.A. Hunter, 1980, 8 p.

On May 9, 1979, a small meteorological station was set up at Illisarvik to measure air temperature and precipitation. The station was located within site and to the northeast of the trailer. Also on May 9, a snow course was run to obtain information on snowpack distribution and water equivalent.

2921 ANDERSON, J.C. - 1984
Hydrologic studies in the Mackenzie Delta Region, N.W.T., 1982; *Env. Can.*, Nat. Hydro. Res. Inst. internal report, 38 p.

Hydrologic investigations continued during 1982 at several watersheds in the taiga and tundra zones of the eastern Mackenzie Delta Region, N.W.T. Data were gathered on snowpack water equivalent, river channel and culvert icings, precipitation, air temperature, river discharge and suspended sediment. Culvert icings to the south of Inuvik varied in magnitude, while to the north, a large icing recurred on Hans Creek, upstream of the proposed highway crossing. Late winter snowpack water equivalents were above normal at Inuvik airport and of intermediate magnitude at the tundra sites. Due to cold weather in May, snowmelt commenced relatively late and caused the largest flows of the 1982 season. Analysis of historic instantaneous versus mean daily flood maxima indicates instantaneous to daily flow ratios have been generally less than 5:4, except at Km 1512.4 where ratios have been higher. Based upon that, it appears that the 1982 snowmelt flood maxima were all intermediate in magnitude. Following snowmelt, an extended period of warm, very dry weather resulted in extremely low flows by the end of July at all sites except Zed Creek. Some increase in flow occurred in late summer at most basins as precipitation returned to more normal levels.

2922 ANDERSON, J.C. - 1984
Highway-related hydrologic studies Mackenzie Delta Region, N.W.T., 1983; *Env. Can.*, Nat. Hydro. Res. Inst. internal report, 39 p.

Hydrologic investigations continued during 1983 at several watersheds in the taiga and tundra zones of the eastern Mackenzie Delta Region, N.W.T., Data were gathered on snowpack water equivalent, river channel and culvert icings, precipitation, air temperature, and river discharge. Culvert icings to the south of Inuvik were low in magnitude except at Km 1512.4 and Caribou Creek where thicker than normal accumulations were measured. To the north, a large icing recurred on Hans Creek, upstream of the proposed highway crossing. Winter snowfall at Inuvik airport was slightly less than normal, but cold weather in May allowed the snow to persist such that by mid-May the snowpack water equivalent was above average. Water equivalents in the tundra zone were moderate in mid-May. Snowmelt runoff commenced in late May and caused the largest flows of the 1983 season. Based upon previous analysis of historic instantaneous versus mean daily flood maxima, it appears that the 1983 snowmelt flood peaks were intermediate or low in magnitude. Following snowmelt, an extended period of warm, very dry weather resulted in extremely low flows by the end of July at all sites. Minor increases in flow occurred in late summer at some basins as precipitation returned to more normal levels.

2923 ANDERSON, J.C. - 1985
Highway-related hydrologic studies Mackenzie Delta Region, N.W.T., 1984; *Env. Can.*, Nat. Hydro. Res. Inst. internal report, 45 p.

Hydrologic investigations continued during 1984 at several watersheds in the taiga and tundra zones of the eastern Mackenzie Delta region, N.W.T. Data were gathered on snowpack water equivalent, river channel and culvert icings, precipitation, air temperature, and river discharge. Culvert icings to the south of Inuvik were generally low to moderate in magnitude. To the north, a large icing recurred on Hans Creek, upstream of the proposed highway crossing. Snowfall measured at Inuvik airport during the 1983-84 winter was two-thirds of the normal, while at the nearby upper air station, late winter snowpack water equivalents were within 5% of the mean. At Tuktoyaktuk, winter precipitation was close to normal. Snowmelt runoff commenced in mid-May in the taiga zone as well as at Ryan Creek, and about two weeks later at Hans Creek, the northernmost site. The snowmelt flood peaks, which occurred between May 19 and June 7, represented the largest flow events of the season, as per usual. The 1984 flow maxima were relatively low overall, in comparison with former years. Long recessions followed the snowmelt flood until August, when heavy rainfall caused relatively minor increases in discharge to occur. Total open water season runoff varied from a low of 48 mm at Rengleng River basin to 168 mm at Ryan Creek basin.

2722 BARSCH, D. - 1981
Terraces and fluvial activity in relation to the model of excessive valley formation in the Oobloyah Bay region, northern Ellesmere Island, N.W.T., Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 163-201.

2924 DUBREUIL, M-A., and WOO, M-K. - 1984
Problems of Determining Snow Albedo for the High Arctic: Research Note; *Atmosphere-Ocean*, vol. 22, no. 3, pp. 379-386.

The measurement of radiation fluxes suffers from inaccuracies at low solar elevations and this poses a problem for determining the snow albedo at high latitudes. From the data of Resolute, NWT, three situations were observed: (1) an often-reported situation when albedo decreases with increasing solar elevation, (2) an inverse situation when albedo increases with increasing solar elevation and (3) no obvious relationship. There were also cases when albedo exceeded 100%. The possible causes for such anomalous conditions or for erroneous albedos include instrument response deviating from the cosine law, instrument tilt, sensing of the sun by the inverted pyranometer and change in the spectral quality of incoming radiation with changing solar height. However, omission of the radiation values measured during the period of low solar elevation will not seriously affect the prediction of snowmelt. In this note, we have identified the anomalies and suggested possible causes; but further investigations are required to verify the causative mechanisms.

2925 FLÜGEL, W-A. - 1981
Hydrological investigations on the water balance of high arctic catchment areas in the Oobloyah Valley, northern Ellesmere Island, N.W.T., Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 311-382.

During the "Heidelberg Ellesmere Island Expedition" to Oobloyah Bay, the author was able to carry out hydrological research on the following topics: 1) Hydrological dynamic during the period of snowmelt, 2) Hydrogeological areas and their physical soil parameters, 3) The change of soil moisture in the slope sediments, 4) The discharge curve of the investigated receiving streams, 5) The summer water balance.

2926 FLÜGEL, W-A. - 1981
Hydrochemical investigations of precipitation, soil water, lakes and rivers of the Oobloyah Valley, northern Ellesmere Island, N.W.T., Canada; *in* Results of the Heidelberg Ellesmere Island Expedition, eds. D. Barsch and L. King, Univ. Heidelberg, Heidelberger Geographische Arbeiten, vol. 69, pp. 383-412.

During the arctic summer 1978 hydrochemical investigations were carried out in the area of Oobloyah Valley. Samples of precipitation, soils, lakes and rivers of different types (periglacial, glacial and mixed glacial/periglacial) were analysed.

The following results can be presented: 1) All precipitations had similar chemical characteristics, except those of July 16, that show a significant high peak in sulphate with concentrations of 12 mg/l. In the first days of August concentrations of hydrocarbon decrease infact of the short way of transport from the Oobloyah Bay and from diluting processes; 2) The chemistry of soil water is mainly affected by the subsoil relief of the permafrost-table. If the draining soil water cannot discharge, as this happens in the sediment of the frostboils, the concentration of soil water in the wet zone beneath the top of the frost boil increase; 3) The chemistry of the two examined lakes especially the calcium content is strongly related to the course of concentration of soil water at station II which was installed in moraine sediment. Precipitation causes dilution, those from 16th of July an increase of sulphate concentration; 4) The three examined rivers show, according to their hydrological types, different chemical behaviour. Causal connections to other hydrometric parameters (discharge, air temperature, precipitation) could be found only for the periglacial Peri Creek. In this creek the soluted freight is increasing meanwhile the daily discharge decreases. The concentration of calcium in the glacial Nukapingwa River is dependent on the area of the river bed which is flooded during high water level. In the mixed glacial-periglacial Heidelberg River the amount of potassium and sodium is correlated to the transport of silt sediment in the river which is eroded in the upper parts of the river. Those ions were absorbed by this material and were exchanged during the time of storing the samples till they were analysed in the laboratory; and 5) Only in the Peri Creek we found a correlation between the total diluted freight and the daily discharge. The linear regression between these two parameters is not very strong and therefore it is not useful to compute the diluted freight by the daily discharge.

2927 FORBES, D.L. - 1979
Bottomfast ice in northern rivers: hydraulic effects & hydrometric implications; *in* Proc. Can. Hydrology Sym.: 79, May 10-11, 1979, Vancouver, B.C., Assoc. Comm Hydrology, Nat. Res. Council Can., pp. 176-184.

Bottomfast ice is characteristic of many northern rivers with negligible flow in winter. In rivers draining the Alaska and Yukon North Slope, initial flow in spring occurs over winter ice, which forms a temporarily raised channel bed. The ice-fill is removed by a combination of melting, abrasive erosion, and structural failure. Data from the lower Babbage River indicate that total flow resistance over the ice is initially lower than, but with time converges on, that observed for equivalent discharge under ice-free conditions. Ripple bedforms develop on the ice surface and may enhance the rate of thermal degradation and increase resistance to flow. Bottomfast ice and ice jams may, individually or in combination, alter the stage-discharge relation, causing flooding of bars and low terraces at anomalously low flows. Although bottomfast ice protects the channel bed from scour, the peak stage, peak discharge, and maximum scour at the Babbage River site in 1975 and 1976 occurred after disappearance of ice from the channel. Because of the presence of bottomfast ice, reliable hydrometric data for many North Slope rivers, prior to mid-June, can be obtained only by frequent observation and direct discharge measurement.

2928 LAPOINTE, M.F. - 1984
Patterns and processes of channel change, Mackenzie Delta, N.W.T.; *Env. Can.*, Nat. Hydro. Res. Inst., 1983-84 Progress Report, 52 p.

In 1983, a study was initiated of fluvial processes in the Mackenzie Delta. Between spring break-up and autumn low-flows, reconnaissance observations of channel conditions and processes were carried out mainly in the eastern-middle Delta, along Napoiak Channel to Shallow Bay and along East Channel and beyond to Point Separation. Preliminary conclusions on channel morphology, channel shifting and sediment transport are presented, based on reconnaissance and previously published data. Further research avenues are also discussed.

Characteristics of delta channel morphology confirmed by the author's bathymetric surveys include widespread "inner channels" as well as chaotic "hole and mound" zones on channel beds. Analysis of published cross-sectional data also suggests that channel depths increase particularly slowly with increasing widths in the Mackenzie Delta. Extensive 30-year air photo comparisons disclose rapid shifting along Middle Channel, which contrasts with subdued shifting along most other Delta channels. The study of these shifting patterns as well as observations of erosion processes during and after breakup suggest that flow strength may exert the main control on channel shifting, while hydrothermal and ice-run erosion appear to play minor roles. Exploratory bed material sampling supports a model of summer-long sand evacuation from distributary channel beds, with the morphology of distributary junctions playing a major role in controlling the sand supply. Avenues for further research include the genesis of "channel within channel" cross-sections, the controls on distributary abandonment, as well as further testing of the conclusions on channel shifting and sediment transport.

2782 LEWKOWICZ, A.G. - 1983
Erosion by overland flow, central Banks Island, western Canadian Arctic; *in* Proc. 4th Intern. Conf. on Permafrost, Nat. Academy Press, Washington, pp. 701-706.

2790 MACKAY, J.R. - 1983
Downward water movement into frozen ground, western arctic coast, Canada; *Can. J. Earth Sci.*, vol. 20, no. 1, pp. 120-134.

2792 MACKAY, J.R. - 1983
Pingo growth and subpingo water lenses, western Arctic Coast, Canada; *in* Proc. 4th Intern. Conf. on Permafrost, Nat. Academy Press, Washington, pp. 762-766.

2929 MARSH, P., and WOO, M-K. - 1984
Wetting Front Advance and Freezing of Meltwater Within a Snow Cover 1. Observations in the Canadian Arctic; *Water Resources Res.*, vol. 20, no. 12, pp. 1853-1864.

In a naturally stratified snow cover the movement of meltwater into dry snow is complicated by the interaction of the wetting front with stratigraphic horizons. Field observations showed that when the wetting front reached premelt stratigraphic horizons, water ponded at the interface and then flow fingers developed and penetrated the lower stratum. The flux in these fingers, which was increased to about twice that of the surface flux, was used to feed water to the impeding horizons where it froze to form ice layers. These ice layers were the major source of latent heat released within the snow cover, and they were responsible for the warming of the snow and the underlying soil. These continuous ice layers grew only at stratigraphic boundaries. Because of this ice layer growth the wetting front advance was retarded, and the arrival of meltwater at the snow cover base was significantly delayed. Owing to a cold substrate the strong heat flux from the snow into the soil delays the warming of the snow cover and limits runoff after the snow is isothermal at $0^{\circ}C$ by the refreezing of soil infiltration and the development of a basal ice layer.

2930 MARSH, P., and WOO, M-K. - 1984
Wetting Front Advance and Freezing of Meltwater Within a Snow Cover 2. A Simulation Model; *Water Resources Res.*, vol. 20, no. 12, pp. 1865-1874.

A simulation model is developed which incorporates the effect of flow fingers at the leading edge of the wetting front, ice layer growth within and at the base of the snow cover, and meltwater infiltration into the underlying frozen soils. The model results demonstrated that ice layers grow rapidly over a 24- to 36-hour period due to the conduction of heat into the snow and underlying soil. Sufficient water is frozen as ice layers to slow the finger wetting front and to account for the rapid snow and soil warming. Wetting front advance

and ice layer growth were found to be sensitive to snow temperature, thermal conductivity, volume of flow in the fingers, and irreducible water saturation. Simulation of a warm snow cover showed that with reduced ice layer growth the flow fingers were able to transmit rapidly water to the snow cover base before the entire snow cover was wet. In the arctic situation the soil was sufficiently cold to ensure basal ice growth throughout the melt period. Basal ice growth was found to be sensitive to soil infiltration, length of the growing period, and the snowmelt rate. As a result of the negative soil heat flux, all meltwater is not available for runoff until both the liquid and thermal requirements of the snow and soil have been satisfied.

2931 MARSH, P. - 1985
Mackenzie Delta, Lake Hydrology Progress Report; *Env. Can.*, Nat. Hydro. Res. Inst., Progress Report, 28 p.

The hydrology of a typical high connection lake in the Mackenzie Delta near Inuvik, N.W.T. was studied over the period June to September 1984. During this period precipitation directly onto the lake surface accounted for 95% of the total water input to the lake. Surface flow and supra- permafrost groundwater flow from the surrounding drainage basin was limited by the high evaporation rate from the forest. As a result surface and groundwater flow from the basin contributed only 5% of the total water supply. Evaporation from the lake was responsible for 62% of the total losses, while surface outflow early in the summer accounted for the remaining 38%.

Evaporation from the lake was greater than precipitation and in fact total outputs from the lake were greater than total inputs over the summer period. As a result lake levels declined over the summer. The major conclusion of this report is that high connection lakes, like NRC Lake, depend on the spring flood water from the Mackenzie River or snow melt runoff from the surrounding basin to replenish lake levels. Without these sources of water, these high connection lakes would soon disappear.

A simulation model was used to predict changes in lake levels over the summer period. Predicted lake levels were similar to those measured. Further work will extend this model to cover the spring flood period as well as the summer period.

2709 McNEELY, R., and GUMMER, W.D. - 1984
A Reconnaissance Survey of the Environmental Chemistry in East-Central Ellesmere Island, N.W.T.; *Arctic*, vol. 37, no. 3, pp. 210-223.

2808 MICHEL, F., and FRITZ, P. - 1982
Laboratory and field studies to investigate isotope effects occurring during the formation of permafrost - Part IV; *Energy, Mines & Res. Can.*, Earth Phys. Br. Open File No. 82-5, 83 p.

2809 MICHEL, F.A. - 1982
Isotope investigations of permafrost waters in northern Canada; unpub. Ph.D. thesis, Univ. Waterloo, 441 p.

2810 MICHEL, F.A., and FRITZ, P. - 1982
Significance of isotope variations in permafrost waters at Illisarvik, N.W.T.; *in* Proc. 4th Can. Permafrost Conf. March 2-6, 1981, Calgary, Alta., Nat. Res. Council, The Roger J.E. Brown Memorial Volume, pp. 173-181.

2811 MICHEL, F.A., and FRITZ, P. - 1983
Isotope investigations in permafrost regions; *Energy, Mines & Res. Can.*, Earth Phys. Br., Final Report, Open File No. 83-3, 63 p.

2697 OHMURA, A. - 1984
Regional water balance in the mountainous Arctic and its application for water-resource planning; *in* Applied Climatology, Proc. 25th Inter. Geographical Congress, Sym. No. 18: Applied Geography, eds. W. Kirchhofer, A. Ohmura and H. Wanner, Zurich, August 20-21, 1984, pp. 67-77.

2830 POLLARD, W.H., and FRENCH, H.M. - 1983
Seasonal frost mound occurrence, North Fork Pass, Ogilvie Mountains, northern Yukon, Canada; *in* Proc. Fourth Inter. Conf. on Permafrost, Nat. Academy Press, Washington, D.C., pp. 1000-1004.

2932 TERROUX, A.C.D. - 1981
Thermal infrared and photography of major Liard and Fort Nelson River confluences 1978-80; *Env. Can.*, Nat. Hydro. Res. Inst. A report under the 1978-81 Federal-Provincial Study Agreement respecting the water and related resources of the Mackenzie River Basin, 110 p.

This report begins with a short description of the thermal infrared portion of the electromagnetic spectrum and the instrumentation required to obtain measurements of surface temperature, before proceeding with the analysis of the 1978 data obtained over the confluences of the Liard River with the Toad, Beaver, Fort Nelson, Petitot, South Nahanni and Mackenzie Rivers as well as a short discussion of the Mackenzie/North Nahanni confluence. Imagery flown during 1979 was not of sufficient quality to further the project, however, the 1980 flight was successful and is described at length. A discussion of the available hydrometric data is included as Chapter 4 in which the mean daily flow is divided among the Liard and most of the surveyed tributaries.

Finally, in the summary chapter, the data from the three years are brought together and an assessment of the infrared and photographic techniques for determining mixing patterns in a remote river system such as the Liard is presented.

2933 WOO, M.-K. - 1983
Hydrology of a Drainage Basin in the Canadian High Arctic; *Annals of the Assoc. of American Geographers*, vol. 73, no. 4, pp. 577-596.

Hydrologic research in the permafrost region has focused mainly upon individual processes. This study integrates the various processes acting on a High Arctic drainage basin, emphasizing the roles played by the energy balance, the uneven snow cover, and permafrost

at shallow depths. Long polar winters cause substantial energy losses from the snowpack and the ground. Snowmelt begins in late May or June, and the melt within a basin is complicated by the uneven thickness of the pack. When the shallower snow disappears, the frozen ground in the snow-free areas begins to thaw and to lose water through evaporation, while the residual snow patches continue to release meltwater to the basin slopes. The mode of slope runoff is strongly controlled by the thawing of the active layer. When the thaw depth is shallow and the water supply large, much of the runoff appears as surface flow. As thaw depth increases, subsurface flow prevails. When this water reaches the valleys, it encounters massive snowpacks that retard downstream flow. Over three-quarters of annual discharge is released during the melt period, but occasional high-flow events are also produced by summer rainstorms. About 80 percent of annual precipitation occurs as snowfall, and about 70 percent of total precipitation leaves the basin as runoff. Snow plays a dominant role in Arctic hydrology, with surface energy providing the driving force to generate snowmelt, evaporation, and the annual thawing of the active layer.

2934 WOO, M.-K. - 1984
Water Balance Studies in the Canadian Arctic Archipelago; *in* Studies in Canadian Regional Geography, Essays in Honor of J. Lewis Robinson, ed. B.M. Barr, Tantalus Res. Ltd., Vancouver, B.C., B.C. Geographical Series no. 37, pp. 38-51.

Water balances for small Arctic basins are often difficult to calculate because of inadequate and inaccurate data for precipitation, runoff, evaporation and basin storage. A six-year study shows that, for a given basin, the large year-to-year variations occurring in the magnitude of the water balance's components indicate a need for a long-term data base. Regional differences in the water balance reflect spatial variation in precipitation: the magnitude of various water balance components tends to be higher for the Eastern Arctic. Runoff usually consumes the bulk of annual precipitation, a typical feature of Arctic environments.

Hydrological research in the Arctic, has advanced in the last several decades, but basic hydrometeorological data are still quite sparse. Regional studies of the water balance of the Arctic archipelago thus continue to be formidable tasks. As development progresses into the last terrestrial frontier of Canada, the demand will increase for better information on water balances. Research on the regional water balance of the Arctic has, therefore, many practical applications as well as considerable scientific merit.

2935 WOO, M.-K. - 1984
Simulating the effects of dust on arctic snowmelt; *in* Proc. Fifth Northern Res. Basins Sym.: The Role of Snow and Ice in Northern Basin Hydrology, Vierumäki, Finland, March 19-23, 1984, pp. 5.97 - 5.116.

Development of resources and communication centres in the Arctic causes a large amount of dust to be deposited on the snowpack, thus altering the natural regime of melt. A model was formulated to simulate such dust effects, using empirical equations obtained for a village in the Canadian Arctic Islands. Simulation was performed for the melt season of 1981, assuming dust loads ranging from 10 to 200 g/m^2. Results indicate that sublimation was considerable, and the dominant heat source for snowmelt came from the radiation component of the energy balance. The radiation balance was particularly responsive to a change in dustiness when the dust load dropped below 40 g/m^2. This suggests that the melting of relatively clean snow may be accelerated by increasing the amount of dust, but for snow that is already dirty, adding more dust will not be as effective in quickening the melt rate.

2936 WOO, M.-K., and DUBREUIL, M-A. - 1985
Empirical relationship between dust content and arctic snow albedo; *Cold Regions Sci. and Technology*, vol. 10, pp. 125-132.

To provide empirical equations that quantify the effects of dust upon snow albedo and the radiation balance in a High Arctic environment, research was carried out at two sites, one within and the other outside the settlement of Resolute. At the settlement, the amount of dust on the snow was several orders of magnitude larger than outside Resolute. The main sources were the unpaved runway and roads. The dust reduced snow surface albedo, resulting in considerable net radiation input to the snowpack. Empirical relationships can be easily obtained to predict the effects of dust on snow albedo and hence the net radiation. It is suggested that during the snowmelt period, radiation data from the government station may not be representative because it is affected by the dusty conditions of the town.

ICE ISLAND

2937 JEFFRIES, M.O. - 1985
Physical, chemical and isotopic investigations of Ward Hunt Ice Shelf and Milne Ice Shelf, Ellesmere Island, N.W.T.; unpub. Ph.D. thesis, Univ. Calgary, 310 p.

The object of the research was to investigate the growth and structure of Ward Hunt and Milne Ice Shelves which have recently produced ice islands. The work involved ice core drilling and collection of snow and fiord water samples. These have been the subject of conductivity (SEC)-salinity, ^{18}O, tritium, ice density and ice texture analysis. According to these parameters, ten ice types have been identified and each is found in or adjacent to the ice shelves and plays a role in their growth and structure.

Ward Hunt Ice Shelf is largely composed of three types of basement ice, which are the product of a sequence of processes which transform first-year sea ice to very old multiyear sea ice, in the absence of ^{18}O depleted meltwater. Milne Ice Shelf is largely composed of glacier

tongues which flowed into and coalesced in Milne Fiord. The ice tongues and the basement ice acted as stable platforms for further ice shelf thickening through snow and ice accumulation. The latter involved percolation and refreezing of meltwater, with attending isotopic homogenization and enrichment from snow δ values of -31.0 $^{o}/_{oo}$ to ice δ values of -29.2 $^{o}/_{oo}$. During periods of negative surface mass balance, meltwater accumulates in meltwater lakes in the summer and refreezes to trough ice ($\delta^{18}O$, -24.0 $^{o}/_{oo}$) in the winter.

The ice shelves act as dams creating stratified conditions of freshwater (runoff) overlying seawater (Arctic surface water and/or Atlantic water) in Disraeli Fiord and inner Milne Fiord. The freshwater just above the halocline is supercooled; frazil ice forms and floats to the surface and accretes as a freshwater fiord ice with a $\delta^{18}O$ value of -26.0 $^{o}/_{oo}$. During a climatic amelioration ca. 2500/2000 BP to ca. 1600 BP, an extensive freshwater flow beneath Ward Hunt Ice Shelf led to the accretion of a freshwater, ^{18}O depleted ice (-25.5 $^{o}/_{oo}$), which originated with frazil ice growth, and is now sandwiched between basement ice layers. The conductivity and $\delta^{18}O$ value of this ice indicates that frazil ice growth and accretion at the bottom of the ice shelves does not lead to "brackish" basement ice growth as suggested by Lyons et al. (1971).

The re-entrant (or multiyear) sea ice that has grown at the front of Milne Ice Shelf is the closest analogy to "brackish" ice. In this ice, salinity ranges from zero to 2.84 $^{o}/_{oo}$, and $\delta^{18}O$ ranges from -23.8 $^{o}/_{oo}$ to -4.2 $^{o}/_{oo}$. This variation, which is manifested as seasonal and 10 year fluctuations of salinity and ^{18}O, arises from similar variation in the water beneath the ice. Each summer, ^{18}O depleted meltwater dilutes the underlying seawater. At the end of the summer a low salinity-low ^{18}O ice freezes first and is followed by higher salinity-higher ^{18}O winter ice. The annual and 10 year stratification leads to an interfingering of fresh, brackish and saline ice which resembles "brackish ice". Re-entrant ice is influenced by ^{18}O depleted meltwater, but basement ice is not.

The ice shelves have experienced two periods of expansion and two periods of wastage. Re-entrant ice, which precedes basement ice growth, is forming during the present period of ice wastage. If the climate deteriorates, re-entrant ice might be succeeded by basement ice growth and further ice shelf expansion and thickening.

2938 JEFFRIES, M.O. - 1985
Ice Shelf Studies off Northern Ellesmere Island, Spring 1983; *Arctic*, vol. 38, no. 3, pp. 174-177.

In spring 1983 work on the ice shelves of northern Ellesmere Island was continued. A total of 55 m of 7.6 cm diameter ice core was obtained from 10 locations. The longest core of 31.79 m is composed of iced-firn and basement ice and can be divided into three distinct strata according to ice salinity. Oscillating strains in Ward Hunt Ice Shelf were measured with a wire strainmeter. It is suggested that the periodic calving of ice from Ward Hunt Ice Shelf might be related to the effects of the high frequency oscillation of 35s to 40s. Ice conditions along 150 km of coastline continue to change. Continued monitoring of the ice shelves and landfast ice is believed to be necessary in view of the offshore development in the Beaufort Sea.

2939 SACKINGER, W.M., SHOEMAKER, H.D., SERSON, H., JEFFRIES, M.O., and YAN, M. - 1985
Ice Islands as Hazards to Arctic Offshore Production Structures; *in* Proc. 17th Annual Offshore Technology Conf., Houston, Texas, May 6-9, 1985, pp. 399-408.

Consideration is given to the hazard presented by moving ice islands. A review of ice island occurrences, as reported in the literature, is supplemented by details of our observations of several recently-discovered ice islands north of Ellesmere Island. Systematic traverses of the edge of the ice shelves for the past two decades have revealed ice island generation to be the rule. Thickness and ice type can be inferred from ice shelf studies, which include crystallography, salinity and temperature profiles. Ice island trajectories, after calving from the ice shelves, are related to winds and internal pack ice stress conditions. Suggestions for possible defensive measures are given.

2940 SACKINGER, W.M., SERSON, H.V., JEFFRIES, M.O., SHOEMAKER, H.D., and YAN, M. - 1985
Ice Island Generation and Trajectories north of Ellesmere Island, Canada; *in* Proc. POAC 85, 8th Intern. Conf. Port and Ocean Engineering under Arctic Conditions, Narssarssuaq, Greenland, Sept. 7-14, 1985, vol. 2, pp. 1009-1040.

A review of ice island occurrences, as reported in the literature, is supplemented by details of our observations of several recently-discovered ice islands north of Ellesmere Island. Frequent traverses of the edge of the ice shelves for the past two decades have revealed ice island generation to be commonplace. Ice island thickness and ice type can be inferred from ice shelf studies, and an example of salinity and temperature profile is given. Ice island trajectories, after calving from the ice shelves, are related to wind speed and direction, pack ice conditions near the coastline, and internal pack ice stress.

LOREX

2655 FORSYTH, D.A., and WEBER, J.R. - 1985
Crustal structure of the central Arctic Ocean Basin: Seismic and gravity interpretation of the Lomonosov and Alpha Ridges; *Abstract in* Inter. Workshop on Density Distribution of the Lithosphere, Inst. Geodesy & Photogrammetry, ETH, Zurich, Rep. No. 102, p. 19.

2656 FORSYTH, D.A., and JACKSON, R. - 1984
Alpha and Lomonosov Ridge crustal structures; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 86.

2941 LIVINGSTON, H.D., KUPFERMAN, S.L., BOWEN, V.T., and MOORE, R.M. - 1984
Vertical profile of artificial radionuclide concentrations in the Central Arctic Ocean; *Geochimica et Cosmochimica Acta*, vol. 48, pp. 2195-2203. *LOREX Contr. No. 11.*

The artificial radionuclides ^{90}Sr, ^{137}Cs, ^{238}Pu, $^{239,240}Pu$ and ^{241}Am have been measured in eight water samples collected in 1979, at intervals from surface to bottom, through the ice at the LOREX satellite camp SS near the North Pole. Differences in the concentrations and ratios of these nuclides, compared with values measured, over time, in the various water masses that flow into the Arctic Ocean, can be used as semi-independent checks on rates of flow to the LOREX stations and on residence times in the Arctic Ocean. An unexpected finding was that water labelled with low-level liquid waste from the Windscale plant on the Irish Sea is a major component of the 1500 m LOREX sample, and has reached there in no more than eight to ten years. Even from this one station in the Polar Ocean, estimation of the inventories of the various radionuclides is good enough to emphasize the importance of horizontal advection of the various supply terms to the Arctic.

2671 OVERTON, A. - 1985
Seismic reflection profiles across the Lomonosov Ridge and the Alpha Ridge, Arctic Ocean Basin; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, pp. 85-86.

OCEANOGRAPHY

2715 ASPREY, K.W., and JOHNSTON, B.L. - 1983
Report on C.S.S. Hudson Cruise 83-028, Baffin Island Fjords; *Geol. Surv. Can.*, Atlantic Geoscience Centre internal report, 189 p.

2942 BIRCH, J.R., FISSEL, D.B., CORNFORD, A.B., and MELLING, H. - 1984
Arctic Data Compilation and Appraisal, Volume 7, Canadian Basin-Arctic Ocean: Physical Oceanography - Temperature, Salinity, Current and Water Levels; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci., No. 5, vol. 7, 642 p.

This volume is one of a group of catalogues designed to compile and appraise marine data sets for the Canadian Arctic. For user convenience, the group has been organized with its subject matter divided into three general disciplines: physics, chemistry and biology. The Arctic has been arbitrarily divided into seven geographical areas incorporating, where possible, major oceanographic regions. The format throughout has been structured to facilitate comparison among subjects and regions. With such a large undertaking it is not possible to provide all reports at once. Therefore catalogues which are presently available in the series are indicated on the inside back cover of each volume. Data collection is a continuing process and further updates of the catalogues are planned. Readers are requested to submit corrections and additions by writing the issuing establishment. Such corrections will be incorporated in on-line computerized data set listings and will be continuously available upon request.

2943 BROOKS, D.J. - 1983
Arctic Oceanographic Survey, Barrow Strait, 1983 Field Report; *Fish. & Oceans*, internal report, Ocean Sci. & Surveys, Bayfield Lab., Burlington, Field Report Series No. 83-1, 57 p. *UNPUBLISHED MANUSCRIPT.*

This report describes the third-year field activities for the Barrow Strait project which were carried out in the period February to May, 1983. In March 1981, the Bayfield Laboratory for Marine Science and Surveys initiated long-term monitoring of ocean properties and transport in Barrow Strait. This study is being carried out to obtain information that is required for decisions on year-round shipping through the Northwest Passage. Both government and industry require the oceanographic knowledge not only for judging the design and operation of the proposed transport systems, but also for addressing safety, environmental protection, and regulatory concerns.

The field work described here collects information on the magnitude of short- and long-term variations in the physical, chemical and biological properties of the water in a section of the Northwest Passage. The area includes the entrances to the contiguous waters of McDougall Sound, Peel Sound, and Wellington Channel. The field work is scheduled for the late March - early May period when a stable ice cover is present. Rotary and fixed-wing aircraft are used to transport equipment and personnel to on-ice observation sites from the main logistics base at Resolute.

The field work is a combination of regional surveys of water structure, intended to delimit spatial variations, and of repeated/continuous measurements at two sites to identify temporal variability in physical, chemical and biological properties, and water movements.

Preliminary processing of CTD and G-UMPS data in the field is used not only to determine if additional data sampling is required, but also to determine the depths used in the biological sampling program. The processed data provides a first glance at possible variations in the oceanographic parameters as compared to previous years. This year's extremely cold weather caused, on the average, one metre of extra ice, which produced a deeper surface mixed layer as well as a higher salinity surface layer. There was a general easterly flow at both ice camps, as was observed in other years. At 40 metres the surface mixed layer stops and a different water mass starts. This change is also seen in the animal population; smaller copepods were found in the surface layer, while larger herbivores occurred in the more saline, deeper waters. Measurements of particulate matter in the third week of March suggested that spring production was still relatively remote. The reproductive season for *Calanus hyperboreus* was well underway, but the amount of eggs and nauplii was not as large in the surface layer as seen in 1982. The ice plant production began in mid-April, reaching the equivalent of 14 mg CHl a m^{-2}, which is larger than the plant chloro-

phyll found in the entire water column. The animal community associated with the ice cover is also diverse, but further physiological research is required to study the plant-animal interrelations of the area to clearly establish production patterns and rates.

2570 COTA, G.F. - 1985
Photoadaptation of high Arctic ice algae; *Nature*, vol. 315, no. 6016, pp. 219-222.

2944 FISSEL, D.B., CUYPERS, L., LEMON, D.D., BIRCH, J.R., CORNFORD, A.B., LAKE, R.A., SMILEY, B.D., MACDONALD, R.W., and HERLINVEAUX, R.H. - 1983
Arctic Data Compilation and Appraisal, Volume 6 - Queen Elizabeth Islands: Physical Oceanography - Temperature, Salinity, Currents and Water Levels; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci., no. 5, vol. 6, 214 p.

This volume is one of a group of catalogues designed to compile and appraise marine data sets for the Canadian Arctic. For user convenience, the group has been organized with its subject matter divided into three general disciplines: physics, chemistry and biology. The Arctic has been arbitrarily divided into seven geographical areas incorporating, where possible, major oceanographic regions. The format throughout has been structured to facilitate comparison among subjects and regions. With such a large undertaking it is not possible to provide all reports at once. Therefore catalogues which are presently available in the series are indicated on the inside back cover of each volume.

Data collection is a continuing process and further updates of the catalogues are planned. Readers are requested to submit corrections and additions by writing the issuing establishment. Such corrections will be incorporated in on-line computerized data set listings and will be continuously available upon request.

2945 FISSEL, D.B., KNIGHT, D.N., and BIRCH, J.R. - 1984
An Oceanographic Survey of the Canadian Arctic Archipelago; *Fish. & Oceans*, Can. Contract. Rep. Hydrogr. Ocean Sci., no. 15, 415 p.

The results of a CTD survey of the Canadian Arctic Archipelago are presented. Over a nineteen-day period, March 19 to April 6, 1982, 70 CTD stations were occupied. In addition, nutrient samples were collected at 30 of these locations.

A cold halocline layer is present in Amundsen Gulf and Lancaster Sound but much less evident in other areas. It is suggested that this layer originates in the southeastern Beaufort Sea and in northwestern Baffin Bay due to the large amount of surface salinization associated with the high rate of sea-ice formation expected in these areas. This cold, saline water then descends and is advected into the adjoining areas of Amundsen Gulf and Lancaster Sound, within the Arctic Archipelago. In the transition zone between the Arctic Water and Atlantic Water layers, the temperature-salinity (TS) properties are modified from the western to central portions of the Archipelago. On a constant salinity surface, warming of about 0.1C^0 occurs.

The baroclinic component of the near-surface geostrophic circulation relative to the deeper water within the Archipelago indicates a net movement into Parry Channel from the north, west and south. The resulting eastward current exits through Lancaster Sound. The strongest geostrophic flows, exceeding 15 cm/s, were found in Penny Strait and Byam Martin Channel. More typically, the near-surface geostrophic currents range from 1 to 8 cm/s. In Amundsen Gulf, a weak (<2 cm/s) cyclonic gyre extends over the central portion of Amundsen Gulf, with a relatively strong (10 cm/s) westerly inflow from Dolphin and Union Strait. In western Amundsen Gulf, a clockwise gyre with geostrophic speeds of 4 cm/s flows eastward on the northern side, turns south and exits westward on the southern side.

2946 GIOVANDO, L.F., and HERLINVEAUX, R.H. - 1981
A discussion of factors influencing dispersion of pollutants in the Beaufort Sea; *Inst. Ocean Sci.*, Sidney, B.C., Pacific Marine Sci. Report no. 81-4, 198 p.

The Beaufort Sea Project (BSP) consists of coordinated studies, carried out in the southeastern Beaufort Sea during 1974 and 1975, to accomplish the following tasks: a) to obtain oceanographic, biological and geophysical baseline data; b) to predict the characteristics of the sea climate likely to be encountered during offshore drilling operations; and c) to advise means of countering adverse environmental effects of accidental spills of oil or of other contaminants.

Thirty-nine technical and scientific reports tabulating and analyzing data obtained in the field or in the laboratory were prepared during 1974 and 1975. This report is an overview, providing thorough assessment, interpretation and synthesis of the results of several of these reports.

2661 JONES, E.P., and ANDERSON, L. - 1984
The origin of the nutrient maximum in the Arctic Ocean; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 102.

2947 JONES, E.P., and ANDERSON, L.G. - 1985
The Formation of Arctic Ocean Halocline Properties by Continental Shelf Processes; *in* Proc. 14th Arctic Workshop, Arctic Land-Sea Interaction, November 6-8, 1985, Dartmouth, N.S., pp. 155-156.

A distinctive feature of the central Arctic Ocean is a pronounced halocline between depths of about 100 m and 200 m that separates the cold, relatively fresher Arctic Ocean surface layer from the warmer, more saline Atlantic layer. Associated with this halocline is a prominent nutrient maximum, observed first in the Canada Basin as early as 1948 from the Russian NP-2 Ice Station with subsequent and more complete data being obtained particularly from the T3 Ice Island. The same features but with the nutrient maximum more sharply defined were observed in water column profiles obtained near the North Pole during the LOREX expedition. We found very similar features to those near the North Pole over the Alpha Ridge during the CESAR expedition, and, with the measurement of additional chemical constituents, have been able to suggest a more definitive picture of the halocline water of the Arctic Ocean.

A model proposed for the maintenance of the halocline forms the basis for a description of the distribution of the chemical constituents throughout the halocline. According to this model, the halocline is maintained by cold, saline water formed along the vast continental shelves of the Arctic Ocean during the production of sea ice. This water subsequently advects into the central regions of the Arctic Ocean. The temperature-salinity relationships suggest the halocline is comprised of two types of water, both formed as described above with the shallower region containing the nutrient maximum. We postulate that this maximum is formed as a result of nutrients having either been regenerated on the shelves as a result of the decay of biogenic matter or having reached the shelves by some direct process such as river input or transport from the Bering Sea, then being carried by the cold, saline shelf water to the halocline. Longer residence times on the continental shelves for water forming the upper part of the halocline would allow time for the uptake of nutrients. Different sources of water as well as shorter residence times on the shelves may distinguish the lower halocline water from the upper halocline water. The possibility of different regions being involved in the formation of the halocline will also be discussed.

2948 LEWIS, E.L., and PERKIN, R.G. - 1983
Supercooling and Energy Exchange Near the Arctic Ocean Surface; *J. Geophysical Res.*, vol. 88, no. C12, pp. 7681-7685.

Conductivity, temperature, and depth (CTD) measurements made north of Svalbard, centered around 83°N, 10°E, show regions in which the surface waters are supercooled to a depth of about 8 m. At other locations, warm Atlantic waters advected into the area by the West Spitzbergen current are melting the sea ice. The resulting large horizontal salinity gradients cause intrusive layering with layers at depth sometimes being below their surface freezing point. Supercooling is explained in terms of the pressure dependence of freezing temperature and the existence of ice keels well below the surface. It is noted that the potential heat sink for surface freezing provided by supercooling can be of the same order as that available from heat loss to the atmosphere. At the same time an equivalent amount of ice is being melted off the keels thus constituting an "ice pump".

2941 LIVINGSTON, H.D., KUPFERMAN, S.L., BOWEN, V.T., and MOORE, R.M. - 1984
Vertical profile of artificial radionuclide concentrations in the Central Arctic Ocean; *Geochimica et Cosmochimica Acta*, vol. 48, pp. 2195-2203. *LOREX Contr. No. 11.*

2670 OSTLUND, H.G., and LEE, V. - 1984
Radiocarbon and water isotopes at CESAR; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 103.

2949 PAGE, P. - 1985
Isotopic composition of lacustrine brines in coastal areas of the Central Canadian Arctic; *Abstract in* Proc. 14th Arctic Workshop, Arctic Land-Sea Interaction, November 6-8, 1985, Dartmouth, N.S., pp. 86-87.

Two meromictic lakes in the Central Canadian Arctic Archipelago actually exist below the postglacial marine limit: Lake Garrow is on Little Cornwallis Island, and lies 12 m above sea level. Lake Sophia is located on the eastern side of Cornwallis Island, and is 7 m higher than the adjacent Wellington Channel. Apart from being stratified with respect to temperature and dissolved oxygen, these lakes contain in their deepest part a 25 m stratum of hypersaline water. The chloride concentrations are 2.6 and 1.7 times that of sea water in Lake Garrow (52 ppt) and Lake Sophia (35 ppt). The mixolimnion in both lakes is filled with a mixture of normal meteoric water and sea water (-21.9 ‰ to -23.5 ‰ in $\delta^{18}O$ with respect to V-SMOW, -170 ‰ to -190 ‰ in $\delta^{2}H$), since the salinity is between 2 to 5 ppt. Salinity increases to 15.74 ppt at 9 m depth in Lake Sophia, and 36.06 ppt at 12 m depth in Lake Garrow, which corresponds to the middle of the halocline. Further down, the water has $\delta^{18}O$ and $\delta^{2}H$ values intermediate between sea water and precipitations (-8.9 ‰ to -10.4 ‰ in $\delta^{18}O$ and -70 ‰ to -90 ‰ in $\delta^{2}H$). The deep waters fit on a regression line with a slope of 8 and a slight ^{2}H excess ("d" parameter).

2608 PERCY, J.A. - 1983
Distribution of Arctic Marine Isopods of the *Mesidotea* (=*Saduria*) Complex in Relation to Depth, Temperature, and Salinity in the Southern Beaufort Sea; *Arctic*, vol. 36, no. 4, pp. 341-349.

2950 PERKIN, R.G., and LEWIS, E.L. - 1984
Mixing in the West Spitsbergen Current; *J. Physical Oceanography*, vol. 14, no. 8, pp. 1315-1325.

Twenty-eight profiles of temperature and salinity down to 1 km depth have been measured in the area north from the coast of Svalbard to latitude 84°40'N between 0° and 32°E longitude. They show Atlantic waters of the West Spitsbergen Current entering the Arctic Ocean in a bifilimentary mode, one filament following the coast line and the other, 300 km farther north, apparently following the continental-shelf break. The profiles show these filaments mixing into the ambient water in a series of intrusive layers which are remarkably uniform over distances of hundreds of kilometers. A "triple peak" structure at the Atlantic water maximum is the dominant oceanographic characteristic of the area with salt fingering occurring on the upper surface of the cold intrusions and indications of double diffusive exchanges through the lower surface. A system of eddies or meanders is postulated as the mechanism for the production of multiple fronts allowing the intrusive layers to extend to distances much greater than the internal Rossby radius.

2673 SMITH, J.N., ELLIS, K.M., and JONES, P. - 1984
Sellafield (Windscale) tracers in the Arctic Ocean; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 103.

2855 SYVITSKI, J.P.M., and BLAKENEY, C.P. - 1983
Sedimentology of Arctic Fjords Experiment: HU 82-031 Data Report, Volume 1; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci. No. 12, 935 p.

2856 SYVITSKI, J.P.M. - 1984
Sedimentology of Arctic Fjords Experiment: HU 83-028 and HU 82-031 data report, Volume 2; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci. No. 28, 1130 p.

2951 THOMAS, D.J., MACDONALD, R.W., FRANCIS, A.G., WOOD, V., and CORNFORD, A.B. - 1983
Arctic Data Compilation and Appraisal, Volume 4. Northwest Passage: Chemical Oceanography; *Fish. & Oceans*, Can. Data Rep. Hydrogr. Ocean Sci 5, vol. 4, 200 p.

This volume is one of a group of catalogues designed to compile and appraise marine data sets for the Canadian Arctic. For ease of reference, the group has been organized with its subject matter divided into three disciplines: physics, chemistry and biology. The Arctic has been arbitrarily divided into seven geographical areas to include, where possible, major oceanographic regions. The format has been structured to facilitate comparison between subjects and regions. With such a large undertaking it is not possible to provide all reports at once. Therefore catalogues which are presently available in the series are indicated on the inside back cover of each volume.

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2952 TOPHAM, D.R., PERKIN, R.G., SMITH, S.D., ANDERSON, R.J., and DEN HARTOG, G. - 1983
An Investigation of a Polynya in the Canadian Archipelago 1, Introduction and Oceanography; *J. Geophys. Res.* vol. 88, no. C5, pp. 2888-2899.

In certain parts of the Canadian Archipelago, small localized areas of water remain ice free throughout the winter, despite the extreme temperature differences between the atmosphere and the ocean surface. One such area, close to Dundas Island, has been studied in detail, both from the point of view of the atmospheric/oceanic heat exchange over the open water and its local geographic and oceanographic context. This paper describes the oceanography of the area and local weather and tidal flow conditions. A significant feature of the oceanographic records is a strong modulation of near-surface ocean temperature at tidal frequencies involving temperature differences as great as 0.2°C within a single tidal cycle. For the most part, the surface waters are 0.1° to 0.2°C above freezing. The presence of this relatively warm surface water is thought to be due to upward mixing occasioned by fast tidal flows across the shallow sill connecting Dundas and Devon islands. Historical records of water properties in the Sverdrup Basin lying to the north of the polynya area show temperatures substantially above freezing point at depths of 50 m and below. This readily accessible body of warm water is thought to be the source of the sensible heat required for the existence of the polynya. This is supported by existing current measurements which suggest a mean southerly transport in the channels leading into and out of the region of the polynya site. A tentative application of the atmospheric heat flux measurements to the whole Dundas Island-Bailey Hamilton Island area suggests that sufficient heat may be lost to affect significantly the water column further south in Crozier Strait and Wellington Channel. The limited information available shows the more southerly waters of these passages to be relatively well mixed and cooled relative to the water of the Sverdrup Basin, just to the north of the Dundas polynya area.

2953 TRITES, R.W. - 1985
Oceanographic Reconnaissance of selected Baffin Island Fjords; *Abstract in* Proc. 14th Arctic Workshop, Arctic Land-Sea Interaction, November 6-8, 1985, Dartmouth, N.S., pp. 54-57.

As part of the Geological Survey of Canada's project SAFE (Sedimentology of Arctic Fjords Experiment) the CSS Hudson undertook two multidisciplinary cruises into selected Baffin Island fjords, one in the period 6-24 Sept., 1982 and the second in the period 19 Sept. - 5 Oct., 1983. The objective of the synoptic physical oceanographic program was to provide a broad general description of the distribution of temperature, salinity, density, dissolved oxygen and nutrients by making measurements at a series of stations from near the head of a fjord to a point seaward of its mouth. During the 1982 survey, measurements were taken in nine fjords: Sunneshine, Coronation, Maktak, Tingin, Itirbilung, McBeth, Inugsuin, Clark, and Cambridge. In 1983 measurements were confined to just three fjords: Itirbilung, McBeth, and Cambridge. Data from these two surveys have been compiled but as yet only limited oceanographic analysis and interpretation have been undertaken.

2678 WALLACE, D.W.R., and MOORE, R.M. - 1985
Vertical profiles of CCl_3F (F-11) and CCl_2F_2 (F-12) in the Central Arctic Ocean Basin; *J. Geophys. Res.*, vol. 90, no. C1, pp. 1155-1166. *CESAR Contr. No. 2.*

2679 WALLACE, D.W.R., and MOORE, R.M. - 1984
F-11 and F-12 distribution in polar oceans; *Abstract in* Can. Geophys. Union, 11th Annual Meeting, Dalhousie Univ., Halifax, N.S., May 29 - June 1, 1984, p. 103.

AUTHOR INDEX

Adams, C.M.
2625

Adams, M.E.
2600

Adams, P.
2684

Addison, P.A.
2626

Aksu, A.E.
2648, 2649, 2650, 2664

Allan, R.B.
2559, 2560

Allen, V.S.
2662, 2886, 2904

Alpert, P.
2642

Alt, B.T.
2630, 2635, 2685, 2686

Amos, C.L.
2651, 2658

Anderson, J.C.
2920, 2921, 2922, 2923

Anderson, L.G.
2661, 2947

Anderson, R.J.
2952

Andrews, J.T.
2714

Arnold, C.D.
2539, 2540, 2541

Asprey, K.W.
2715

Asudeh, I.
2652, 2885, 2888

Audretsch, A.
2833

Bada, J.L.
2561

Balkwill, H.R.
2716, 2717, 2718

Baragar, W.R.A.
2824

Barge, B.
2687

Barron, J.A.
2653

Barsch, D.
2562, 2719, 2720, 2721, 2722, 2723, 2905

Beattie, O.B.
2542

Bédard, J.
2583

Bédard, Y.
2583

Bednarski, J.
2724

Bélanger, J.R.
2725

Bernier, L.M.J.
2616

Bertulli, M.
2702

Bielawski, E.
2543, 2544, 2545, 2703

Bigham, J.
2547

Birch, J.R.
2942, 2944, 2945

Blakeney, C.P.
2855

Blasco, S.M.
2656, 2726

Blatter, H.
2906

Bliss, D.I.
2628

Bliss, L.C.
2626, 2627, 2628, 2629, 2644

Bond, W.A.
2563

Borowiecki, A.
2704, 2705

Borstad, G.A.
2564, 2565

Bouchez, J.L.
2866

Bourgeois, J.
2630

Bowen, V.T.
2941

Bradley, R.S.
2688, 2689, 2690, 2699, 2700, 2701

Brooks, D.J.
2943

Brophy, J.A.
2727

Broughton, E.
2602

Bruemmer, F.
2566, 2706

Bukry, D.
2654

Burgess, M.
2886, 2901

Cairns, D.K.
2581

Calambokidis, J.
2571

Calvert, W.A.
2567, 2593, 2595

Campbell, F.H.A.
2728

Chapdelaine, G.
2577, 2578

Choi, D.
2762, 2763, 2764

Christie, K.W.
2729

Clark, C.W.
2624

Clark, D.L.
2730

Clark, M.J.
2756

Cleator, H.
2568

Cody, W.J.
2631, 2632

Coleman, L.C.
2838

Cook, D.G.
2718

Cornford, A.B.
2942, 2944, 2951

Cornish, B.J.
2569

Cota, G.F.
2570

Cronin, F.
2914

Cubbage, J.C.
2571

Cuypers, L.
2944

Dale, J.E.
2572, 2590

Dankers, P.
2778

Davies, E.H.
2731

Davies, S.
2597

Davis, R.A.
2613

Dawes, P.R.
2732

Dawson, E.
2887, 2894

Dawson, M.R.
2573, 2733, 2762, 2763, 2764

de Boutray, B.
2872

de Heering, P.
2556, 2557

Demaster, D.P.
2574

Demeur, P.
2913

Den Hartog, G.
2952

DesParois, M.
2556, 2557

Desrochers, A.
2902

Detterman, R.L.
2718

Dickson, L.
2569, 2575

Dineley, D.L.
2740

Dixon, O.A.
2817, 2819, 2821, 2822

Dorsey, E.M.
2624

Dredge, L.A.
2735

Drury, M.J.
2891

Dubreuil, M-A.
2924, 2936

Dupuis, P.
2610

Dyke, A.S.
2734, 2735, 2736

Edlund, S.A.
2633, 2634, 2635, 2636

Edmonds, J.E.
2618

Egginton, P.A.
2633

Eichler, H.
2737, 2738

Eischeid, J.K.
2690

Elliot, R.D.
2581

Elliott, D.K.
2739, 2740, 2741

Ellis, K.M.
2673

Elson, J.A.
2760

Embry, A.F.
2718, 2742, 2743, 2744, 2862

England, J.H.
2745, 2849

Erickson, R.N.
2563

Evans, C.R.
2613

Fahrig, W.F.
2729

Fischer, B.F.G.
2746

Fisher, D.A.
2694

Fissel, D.B.
2942, 2944, 2945

Flügel, W-A.
2637, 2691, 2925, 2926

Foley, S.
2747

Forbes, D.L.
2726, 2748, 2749, 2750, 2927

Forsyth, D.A.
2652, 2655, 2656, 2658, 2885, 2888, 2889

Fortier, M.
2824

Foster, J.H.
2824

Fox, F.G.
2716

Francis, A.G.
2951

Fransham, P.
2890

French, H.M.
2751, 2756, 2757, 2780, 2781, 2830

Frisch, T.
2732, 2752

Fritz, P.
2808, 2810, 2811, 2890

Frobel, D.
2858, 2859

Fujino, K.
2753

Furnell, D.J.
2576

Fyles, J.G.
2765

Gaston, A.J.
2577, 2578, 2579, 2580, 2581

Gibbins, W.A.
2712, 2727, 2754, 2785

Gilbert, R.
2907

Gillman, D.V.
2582

Giovando, L.F.
2946

Girouard, P.
2797

Giroux, J-F.
2583

Goodman, A.S.
2600

Goodwin, J.A.
2785

Gower, J.F.R.
2564

Gray, D.R.
2584, 2585

Green, A.G.
2652

Greene, C.R.
2586, 2611

Guilbault, J-P.
2872

Gummer, W.D.
2709

Gunn, A.
2601, 2602

Hakansson, E.
2718

Hammill, M.O.
2587

Hardy Associates (1978) Ltd.
2755

Harper, J.R.
2726

Harris, S.A.
2771, 2772

Harry, D.G.
2751, 2756, 2757

Havas, M.
2588

Hay, K.A.
2589

Haythornthwaite, T.W.
2692

Heffler, D.
2660

Heginbottom, J.A.
2758, 2759

Hélie, R.G.
2760, 2761

Herlinveaux, R.H.
2944, 2946

Hett, C.E.S.
2546

Hewitt, R.A.
2590

Hickey, L.J.
2573, 2733, 2762, 2763, 2764

Hobson, G.D.
2915

Hodgson, D.A.
2765, 2766

Holdsworth, G.
2908

Horiguchi, K.
2753

Horn, D.R.
2767

Hugon, H.
2768, 2866

Hunter, J.A.
2547, 2769

Hutchinson, T.C.
2588, 2625

Irving, E.
2770, 2883

Jackson, R.
2656, 2657, 2658, 2659, 2665, 2885, 2888, 2889

Janes, R.R.
2548, 2549

Jeffries, M.O.
2771, 2772, 2909, 2937, 2938, 2939, 2940

Jessop, A.M.
2891

Jodrey, F.
2660

Johnson, G.W.
2892

Johnston, B.L.
2715

Johnston, G.H.
2897

Jonasson, I.R.
2861

Jones, B.
2773, 2801

Jones, E.P.
2661, 2947

Jones, G.A.
2730

Jones, P.
2673

Judge, A.
2662, 2886, 2891, 2901, 2902, 2903

Kato, K.
2753

Kemper, J.B.
2561, 2591, 2603

Kerbes, R.H.
2592

Kerr, J.W.
2850, 2851, 2852, 2853

King, L.
2562, 2638, 2693, 2707, 2719, 2774, 2775, 2905, 2910

Kingsley, M.C.S.
2593, 2594, 2595

Kissin, S.A.
2838

Klassen, R.A.
2725, 2776

Knight, D.N.
2945

Koerner, R.M.
2630, 2694, 2911, 2912

Korczynski, R.E.
2596

Kornik, L.J.
2547

Krawetz, M.T.
2803

Kristofferson, A.H.
2582

Krouse, H.R.
2771, 2772

Kupferman, S.L.
2941

Kurfurst, P.J.
2777

Kurtz, R.D.
2668

Lacho, G.
2597, 2779

Lake, R.A.
2944

Lapointe, M.F.
2928

Lapointe, P.
2778

Laporte, P.J.
2727, 2785

Lawrence, M.J.
2597, 2779

LeDrew, E.F.
2695

Lee, V.
2670

Lehn, W.H.
2708

Lemon, D.D.
2944

Leskiw, K.
2833

Lewis, C.P.
2749

Lewis, E.L.
2948, 2950

Lewis, T.J.
2891

Lewkowicz, A.G.
2780, 2781, 2782

LGL Ecological Research Associates Inc.
2598

Lichti-Federovich, S.
2639, 2783, 2784

Likens, G.E.
2588

Livingston, H.D.
2941

Lord, C.C.
2727, 2785

Lorrain, R.D.
2913

Lortie, G.
2872

Loveridge, W.D.
2864

Lunn, N.J.
2599

Maass, O.
2663

MacAulay, H.A.
2547

Macdonald, R.W.
2944, 2951

MacDougall, J.R.
2558

Mackay, J.R.
2786, 2787, 2788, 2789, 2790, 2791, 2792, 2793, 2794, 2795, 2796, 2893, 2896, 2897

MacKenzie-Grieve, G.R.
2559, 2560

MacLean, B.
2797

Marsh, P.
2929, 2930, 2931

Mary-Rousselière, G.
2550

Mathewson, C.C.
2798

Matthews, J.V. Jr.
2793

Mäusbacher, R.
2637, 2640, 2799, 2800, 2905

May, R.W.
2801

Mayer-Cole, T.A.
2798

Mayhew, C.
2916

Mayr, U.
2802, 2862

McAndrews, J.H.
2641

McCann, S.B.
2803, 2857

McCormick, K.J.
2600

McGhee, R.
2551, 2552, 2553, 2554

McLaren, P.
2804

McNeely, R.
2709

McNeil, D.H.
2884

Melling, H.
2942

Miall, A.D.
2718, 2805, 2806

Michaud, C.
2668

Michel, F.
2807, 2808, 2809, 2810, 2811, 2890

Miller, F.L.
2601, 2602

Miller, G.H.
2714

Miller, N.G.
2642

Mitchell, E.D.
2561, 2591, 2603, 2604, 2605

Mitchell, R.H.
2812

Moore, R.M.
2678, 2679, 2941

Moran, K.
2777

Morris, W.A.
2730, 2874

Morrison, D.A.
2555

Mortimer, A.R.
2919

Mudie, P.J.
2648, 2657, 2658, 2664, 2665, 2666, 2667

Muir, I.D.
2813, 2814

Müller, G.
2723

Nagel, G.
2815

Narbonne, G.M.
2773, 2816, 2817, 2818, 2819

Newitt, L.R.
2887, 2894

Niblett, E.R.
2668

Nixon, F.M.
2777

Nixon, M.
2868

Noble, D.
2669

Noble, D.G.
2577, 2578, 2579, 2581

Norton, P.
2613

O Briain, M.
2606

Occhietti, S.
2872, 2874

O'Connor, M.J. & Associates Ltd.
2820, 2895

Ohmura, A.
2696, 2697, 2698

Okulitch, A.V.
2802

Olsen, E.J.
2838

Osadetz, K.
2883

Osborne, D.
2713

Ostlund, H.G.
2670

Overton, A.
2671, 2899

Packard, J.J.
2816, 2821, 2822, 2823, 2841

Padgham, W.A.
2727, 2785

Pagé, P.
2949

Palecki, M.A.
2699

Palmer, H.C.
2824

Parameswaran, V.R.
2896, 2897

Parkins, W.G.
2825

Payne, R.
2624

Peach, J.
2643

Pedder, A.E.H.
2607, 2826, 2827

Pelletier, B.R.
2779

Percy, J.A.
2608

Perkin, R.G.
2948, 2950, 2952

Phillips, C.
2917

Platt, R.G.
2812

Poey, J-L.
2828

Polan, K.P.
2829

Pollard, W.H.
2830

Poulton, T.P.
2718, 2831, 2832, 2833, 2834

Prince of Wales Northern Heritage Centre
2918

Prytz, K.
2710

Quek, S.H.
2672

Ramsay, M.A.
2609

Reed, A.
2610

Reeves, R.R.
2604

Retelle, M.J.
2835, 2836

Richardson, W.J.
2611, 2612, 2613, 2624

Ricketts, B.D.
2837

Robertson, P.B.
2838, 2839

Robinson, P.T.
2675, 2676

Robson, M.J.
2840

Rohr, D.M.
2841

Rugh, D.J.
2571

Rust, B.R.
2813, 2814

Rutter, N.
2872

Sackinger, W.M.
2939, 2940

Schmidt, M.
2900

Schweinsburg, R.E.
2576, 2614, 2622

Schwerdtner, W.M.
2842, 2843, 2866, 2867

Scotter, G.W.
2631, 2632, 2645, 2646, 2711, 2844

Seaton, J.B.
2727, 2785

Serreze, M.C.
2688, 2689, 2699, 2700, 2701

Serson, H.V.
2939, 2940

Serson, P.H.
2898

Shakur, M.A.
2771, 2772

Sharpe, D.R.
2845, 2846

Shilts, W.W.
2714

Shinbori, M.
2753

Shoemaker, H.D.
2939, 2940

Smiley, B.D.
2944

Smith, G.P.
2847

Smith, J.N.
2673

Smith, S.D.
2952

Smith, T.G.
2568, 2587, 2615

Sobczak, L.W.
2848, 2899, 2900

Spencer, W.
2614

Stearn, C.W.
2829, 2847

Stephenson, C.J.
2600

Stephenson, R.
2885, 2888

Stewart, D.B.
2616

Stewart, T.G.
2849

Stewart, W.D.
2850, 2851, 2852, 2853

Stimmell, C.
2540

Stirling, I.
2567, 2574, 2593, 2595, 2609, 2617

Stuiver, M.
2879

Sullivan, R.W.
2864

Sutcliffe, P.
2556, 2557

Svoboda, J.
2628, 2629, 2712

Sweeney, J.F.
2674, 2770, 2839, 2854

Syvitski, J.P.M.
2855, 2856, 2907

Tanno, K.
2647

Taylor, A.E.
2662, 2886, 2891, 2901, 2902, 2903, 2904

Taylor, H.W.
2712

Taylor, R.B.
2857, 2858, 2859, 2907

Tempelman-Kluit, D.J.
2832

Terroux, A.C.D.
2932

Thomas, D.C.
2618

Thomas, D.J.
2951

Thomson, J.W.
2645, 2646

Thorsteinsson, R.
2860

Timperley, M.H.
2861

Toda, M.J.
2619, 2620, 2647

Topham, D.R.
2952

Torrance, J.G.
2867

Trettin, H.P.
2862, 2863, 2864

Trites, R.W.
2953

Urquhart, D.R.
2621, 2622

Utting, J.
2865

van Berkel, J.T.
2866, 2867

Van Kranendonk, M.
2842

Van Wagoner, N.A.
2675, 2676, 2677

Veillette, J.
2868

Vincent, J-S.
2714, 2730, 2735, 2765, 2766, 2869, 2870, 2871, 2872, 2873, 2874

Völk, H.R.
2875, 2876

Wall, J.H.
2877

Wallace, D.W.R.
2678, 2679

Wardell, G.E.
2713

Washburn, A.L.
2878, 2879

Watts, S.H.
2880, 2881, 2882

Weber, J.R.
2655, 2680, 2681, 2682

Wells, D.E.
2672, 2681, 2683

Wells, R.S.
2612

West, R.M.
2733, 2762, 2763, 2764

White, D.
2885, 2888

Wiggins, G.B.
2623

Williams, D.
2614

Williamson, M.C.
2677

Winchester, N.N.
2623

Woo, M-K.
2924, 2929, 2930, 2933, 2934, 2935, 2936

Wood, V.
2951

Woodside, J.M.
2797

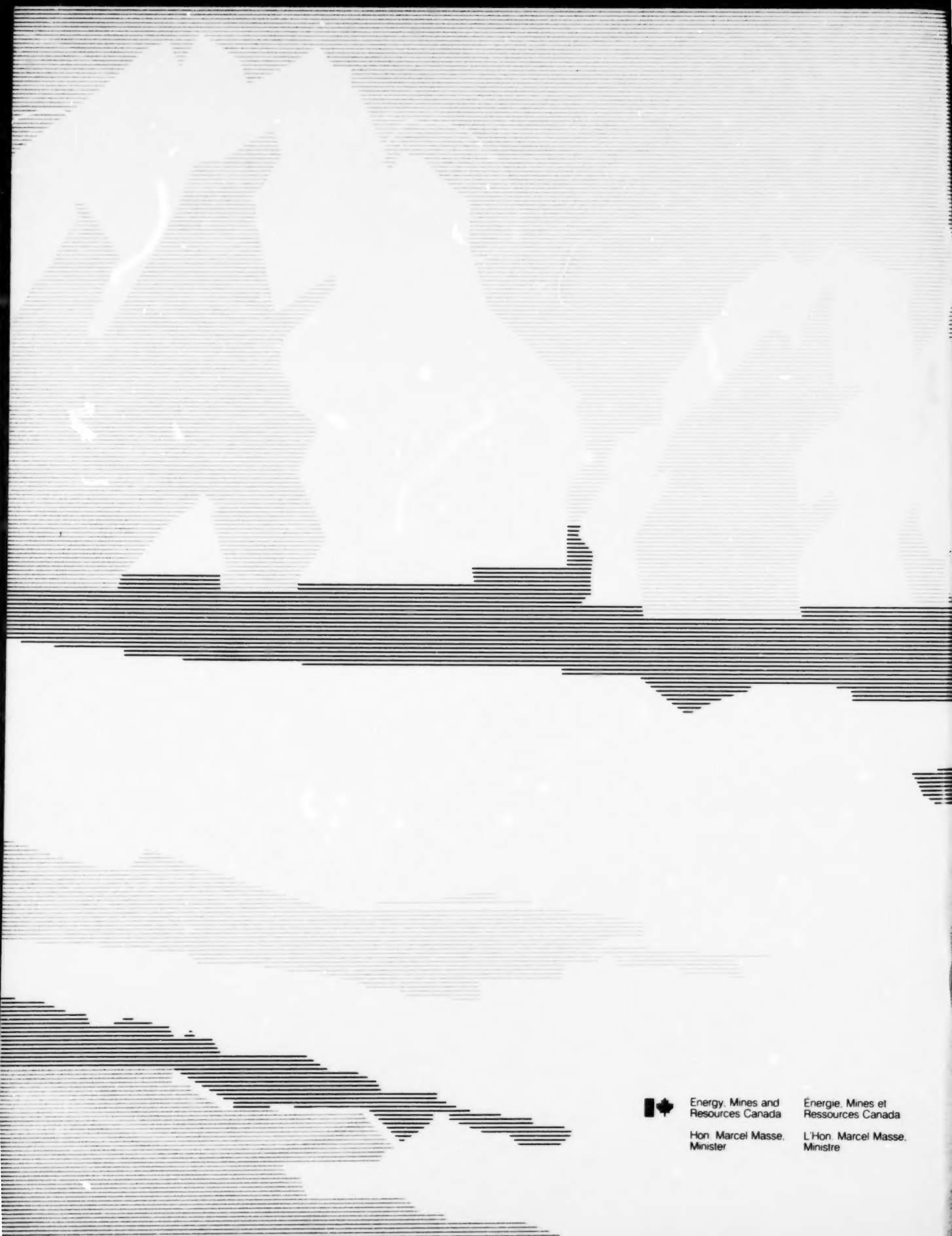
Würsig, B.
2611, 2612, 2624

Wynne, P.J.
2883

Yan, M.
2939, 2940

Young, F.G.
2718, 2884

Zoltai, S.C.
2631, 2632



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